apple

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Computers in Education

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EDITORIAL

Towards Computer Literacy

A hundred years ago, many Americans were ill-prepared for the coming 20th Century because they could neither read nor write. Literacy for the masses was therefore an inescapable goal for the nation's emerging educational system. Now comes the prospect of a vastly different society in the 21st Century—one in which computer data bases will replace the written word as the storage media for man's accumulated knowledge. Once again the nation is looking to its educators to provide the masses with skills required to "read and write" in this new environment.

At this point, many of the educators themselves are still not prepared to utilize the technology and the computer-oriented language of the century ahead. Even when the interest has been there, restrictive budgets and the complexities of large computers have often become roadblocks. Both the interest and the availability are now on the increase, however, thanks in part to the pioneering efforts of some educators who have paved the way.

No other application of the personal computer has such importance and immediacy, since only knowledge *of computing can make it possible for all of society to fully utilize the* power *of computing. The educational challenge extends far beyond the classroom, and, in fact, most educators feel it is the computer in the home which will truly revolutionize the learning process for students, for the handicapped, and for those adults whose profession requires continuing education programs, such as doctors, lawyers and teachers themselves.*

The simple fact is that the personal computer promises to turn the learning process into a lifetime adventure for "students" of all ages. Any development which can accomplish that is worthy of attention.

That is why this inaugural issue of APPLE is devoted to the developments and trends taking place in the educational field, and is dedicated to the pioneers who are leading our society toward computer literacy.

—Walter Mathews

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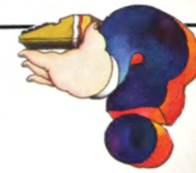

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COMPUTERS AND EDUCATION-THE PROMISE AND THE FULFILLMENT

BY LUDWIG BRAUN

Many of us "old timers" consider ourselves missionaries preaching the gospel of computers in education. For the first time in twenty years, we see the possibility that the message will reach the kids in this country in numbers large enough to matter.

Beginning about 1960, there was a concerted effort by many people to explore and to demonstrate the value of digital computers in learning environments. There was Pat Suppes and Vic Bunderson with Computer Assisted Instruction (CAI); Don Bitzer with PLATO (the most comprehensive computer-based learning tool ever devised); John Kemeney and Tom Kurtz, whose BASIC and time-sharing made computing available to many of us for the first time; Bob Albrecht, Dragon Emeritus of People's Computer Company and champion of kids on computers; Bill Huggins, who, very early, perceived the power of graphics and of simulation in learning; Seymour Pappert, whose LOGO has demonstrated that even young children are capable of developing and implementing complex algorithms; Alan Kay, whose Dynabook is a beacon showing the rest of us the way; Tom Dwyer, whose SOLO and SOLOWORKS gave kids very unusual and powerful learning experiences; and Mike Visich and myself in the Huntington Computer Project, which demonstrated the learning value of computer simulations in a variety of disciplines.

All of these efforts, and many more, have been largely ignored by the educational community. Even now, two decades after it all began, computers affect the learning experiences of no more than two percent of the high school students in a meaningful way. There are many reasons for this, but the most important are:

1. Cost.

When spending for textbooks, films, slides, etc., is measured in pennies per student per hour, school systems have difficulty justifying the expenditure of two-to-five *dollars* per student per hour for computing, no matter how great the benefit.

2. Reliability.

Because of the complexity of interconnection of most time-sharing systems (the primary source of computing power until recently), interruptions of service were too frequent for most teachers to accept. The wasted class time and embarrassment caused by a system crash during a carefully planned class period need be repeated only two or three times before most teachers reject computers.

3. Flexibility.

Because of the size and weight of computers and peripheral devices, and because of the necessity for telephone connections, computer use could only occur in previously planned locations. The learners had to be brought to the computer, rather than having the computer brought into the learning environment.

4. Lack of courseware.

The development of courseware (software focusing on curriculum objectives) requires an amount of

"CLEARLY, THE 'MISSIONARY' PERIOD FOR COMPUTERS IN EDUCATION IS NEARING AN END. IT'S NO WONDER THAT THOSE OF US WHO WERE INVOLVED ARE EXCITED OUT OF OUR SKULLS OVER PERSONAL COMPUTERS."

time not available to most teachers and expertise in a range of areas beyond the training of most of us. This means that the teachers must rely on others to produce the courseware needed for their classes. Because of the small market, there has been little commercial interest in producing courseware, and the burden has fallen largely on the Federal Government to support its development. Federal funds in this area have been limited, and in recent years, almost non-existent. As a consequence, there is more excellent courseware available but only in very limited quantities.

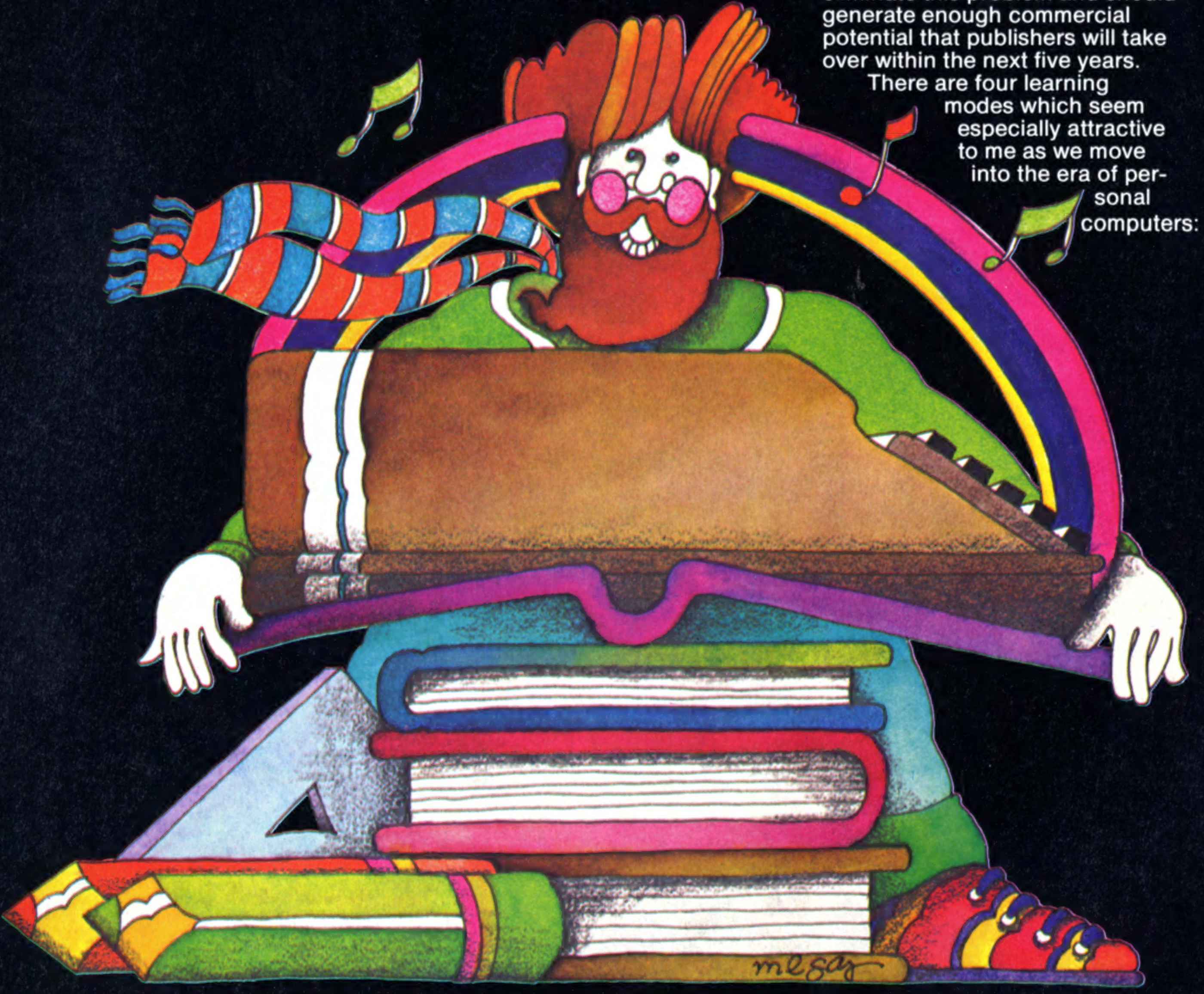
Fortunately, we are in the midst of a computer revolution which started in 1975 with the announcement of the Altair 8800, the first microcomputer available at low prices and in relatively large quantities. In the three years since, there has been a bewildering array of new product announcements, culminating in the personal computer—a microcomputer small enough, inexpensive enough, and simple enough to use that it can be thought of as a personal consumer product.

The personal computer offers educators, for the first time, the opportunity to realize the promise which has been demonstrated over and over during the last two decades of effort. Its purchase cost is so low (less than $1,000 in some cases) that its per-student-hour cost is under twenty cents when amortized over a four-year life; its reliability is dramatically better than that of previous computers because it uses large-scale integrated circuits which require few external connections; and it is so flexible in use because of its small size and weight and because it is a complete self-contained computer, that we can use it in any classroom, office, or home without special planning. It even is conceivable that school systems and local libraries will make arrangements to lend personal computers to students or to local residents as they now do with books, paintings, records, and video cameras.

In addition to solving the problems which have inhibited the penetration of computers into education, personal computers have capabilities few of us even dreamed about until three years ago. These include: graphics (including color in some cases); speech generation and recognition; music generation; and real-time interactions with the real world which permit the computer to control external devices and external devices to control the computer (this capability is especially attractive for the education and environmental improvement of handicapped people).

Unfortunately, despite the marvels of modern personal computers, there is no solution yet to the fourth problem mentioned above—lack of courseware—although the future looks bright even here. There already are over 50,000 personal computers in the hands of consumers, with that number increasing at a rate above ten percent per month. This growth rate has produced two beneficial effects: a new cottage industry has emerged to respond to people's hunger for programs to use on their new personal computers; and the Federal Government has taken notice of this growth and has begun planning to resume its role as catalyst for courseware development. Both of these forces taken together should begin to eliminate this problem and should generate enough commercial potential that publishers will take over within the next five years.

There are four learning modes which seem especially attractive to me as we move into the era of personal computers:



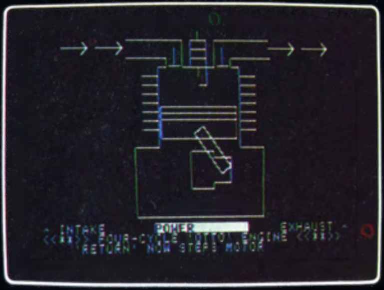
DISCOVERY LEARNING

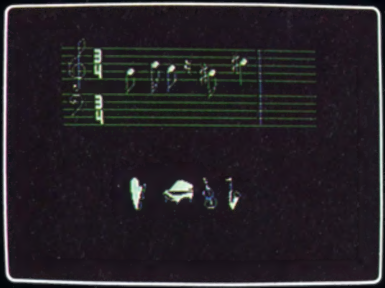
In many situations, students learn most effectively when they have direct experience with the phenomenon under study. This is the major justification for the expenditures of millions of dollars annually to equip, stock, and staff biology, chemistry, and physics laboratories in high schools and in colleges in the United States. Most of the students in these laboratories will not become experimentalists nor even scientists. Rarely, if ever, is a new discovery made in such laboratories. Yet, students seem to understand concepts better when they experience them directly.

Students of mathematics and of the social sciences have not had such experiential learning opportunities available to them until now; but, with the easy availability of personal computers, it should be possible to provide them. I foresee computer-based "laboratories" becoming available to educators to provide discovery learning in biology, chemistry, earth sciences, mathematics, physics, and the social sciences.

COMPUTER AWARENESS

Our society already is so dependent upon computers that our citizens must become aware at least at some minimal level of how computers work, how they are used in our society, and what effects these uses will have on our society. The personal computer is an ideal vehicle for such learning experiences.





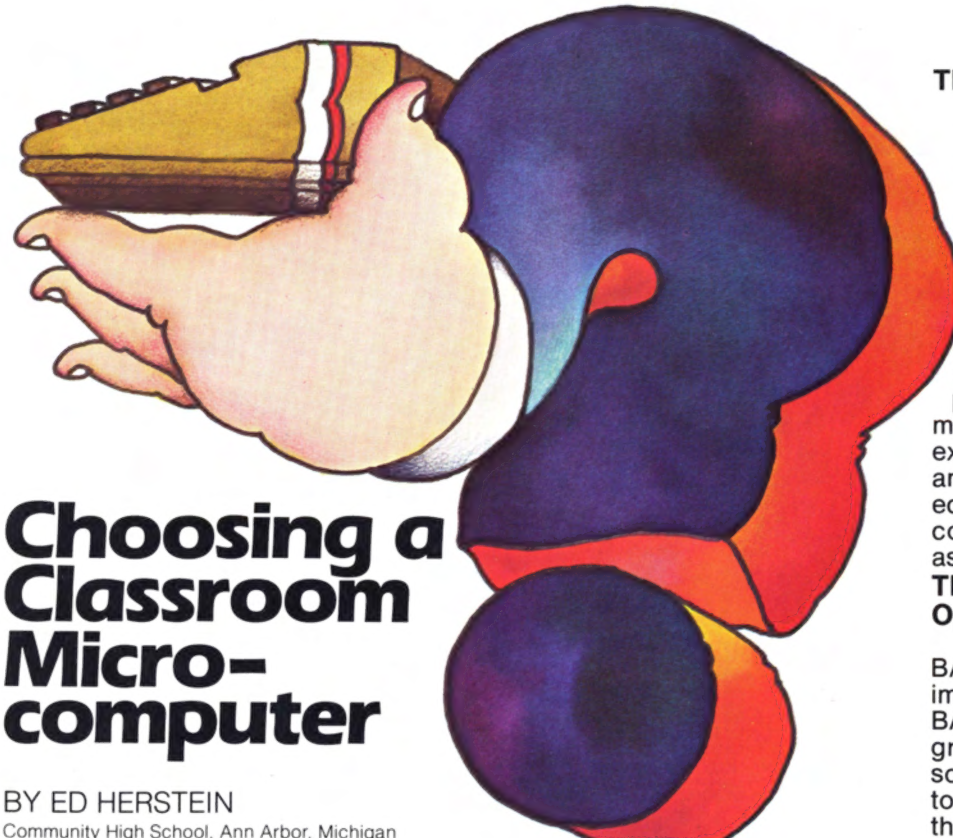
PROBLEM SOLVING

In many disciplines, students are capable conceptually of understanding how to solve problems in that discipline but are not prepared mathematically to execute the solution; hence, they are not presented with the problems and do not develop problem solving skills—skills vital to people in all walks of life. With the computer, students can learn to conceptualize the solution and let the computer execute it.

GRAPHIC AND MUSICAL EXPERIENCE

Many people have the intellectual capability to be creative graphically or musically but do not have the manual dexterity to properly operate a paint brush or to strike the keys on a piano. With the new capabilities of the personal computer, this creativity may be expressed by young children before they develop this dexterity and by older people who never develop it.

Clearly, the "missionary" period for computers in education is nearing an end. It's no wonder that those of us who were involved are excited out of our skulls over personal computers.



Choosing a Classroom Micro-computer

BY ED HERSTEIN
Community High School, Ann Arbor, Michigan

Computers belong in the classroom—that much has become clear to educators who have participated in the "microcomputer revolution" over the last four years.

As one of those fortunate enough to have become involved almost from the start, I am frequently approached by colleagues who are interested in acquiring classroom systems of their own. Some have specific uses in mind—to teach programming, to introduce computer literacy, or to conduct laboratory, social studies, or business simulations. But even among these educators, and certainly among the majority with whom I have spoken, there is a strong sense that a microcomputer would be a valuable learning tool, even if its precise applications are undefined.

This uncertainty is both honest and appropriate when dealing with a technology so new and so powerful. Even the most sophisticated examples of instructional computing today barely suggest the promises that will be realized over the next few years. The door is wide open for any educator with interest and imagination to make a contribution.

How, then, can educators select a microcomputer system which will fulfill their immediate needs, as well as those applications they cannot foresee?

Our experiences at Community High School have begun to suggest some answers. Over the last three years, we have worked with Altairs, Apples, IMSAIs, PETs, and Sorcerers equipped with a variety of terminals, video display boards, math storage devices, and other peripherals. We have found that the systems that have served us best have shared a number of characteristics—characteristics that are likely to continue to be important as instructional computing evolves:

The System Offers Several Means of Input and Display. We have learned that joysticks and other analog input devices add an important dimension to a computer's capabilities, and we are eager to explore the merits of light pens, digitizers, and other alternatives to keyboard data entry. For output, video graphics are essential. It should be possible to add a printer and to interface a video monitor. We are just beginning to experiment with sound and color and hope soon to discover the educational utility to be found in controlling external devices, such as lab instruments and appliances.

The Computer is Easy to Operate and Easy to Program. Most microcomputers use the BASIC language, but there are still important differences. Bringing up BASIC or loading and saving programs is much more difficult on some systems than on others. It is too likely on some microcomputers that a user will inadvertently terminate a program by pressing the wrong key on the keyboard. Screen editing capabilities are sometimes available that make entering or modifying programs much easier. Perhaps most importantly, the languages on some microcomputers have been extended to simplify generating special effects such as color, animation and sound, while on other systems coding is so complex and documentation so poor that these features are accessible only to highly experienced programmers.

Ed Herstein, M.A. (University of Michigan), is an Instructor of Mathematics and Computer Science at Community High School, Ann Arbor, Michigan. Mr. Herstein has been teaching for twelve years and is responsible for establishing the "After-school Project," now in its fourth year. Over two hundred students, ranging from third grade through high school, have participated in the program.

The Computer is Being Used in a Variety of New and Exciting Ways.

Some systems seem to attract particularly innovative and public-spirited programmers. Their work, in turn, is shared and becomes the basis for still more and better software, and the educator's resources grow accordingly. A manufacturer who encourages users' groups and supports contributors' libraries can also do a great deal to promote and facilitate the dissemination of quality materials.

The System Can Easily be Expanded.

We have already outgrown the memory we started with on some of our systems and have realized the importance of being able to add more. New peripherals—printers, plotters, communication interfaces, and devices still unforeseen—are constantly entering the market. As their usefulness becomes apparent, our experience suggests the desirability of being able to integrate such hardware without great difficulty or expense.

The System is Sturdy and Reliable.

Some microcomputers overheat or have keyboards that rapidly wear out. Some cannot be moved around without risking malfunction. Sometimes the most desirable features of a system—a high speed cassette interface or time-sharing capability—are too unreliable for classroom use. The potential for accidentally damaging a system is often too great, as when information on a diskette can be lost if specific steps are not followed when it is loaded and removed from the disk drive. We have lived with computing as an elite activity long enough; you should choose a microcomputer that is not off-limits to inexperienced users.

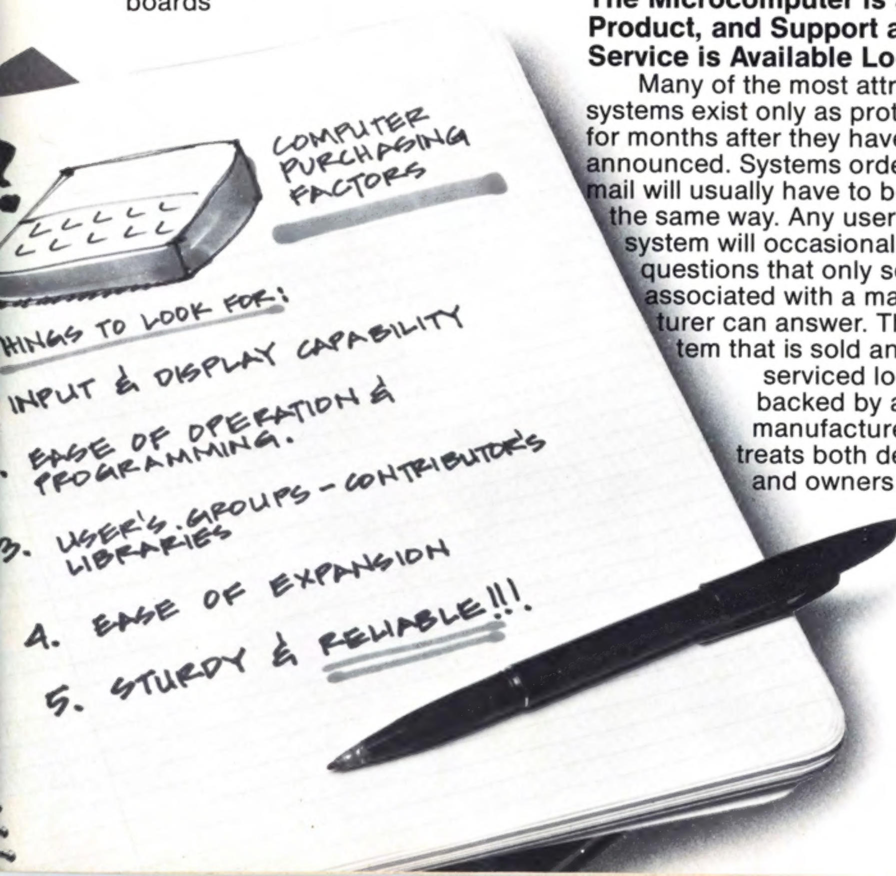
The challenge to educators in selecting a microcomputer is to find one which will fulfill their immediate needs, as well as those applications they cannot yet foresee.

The Microcomputer is a Real Product, and Support and Service is Available Locally.

Many of the most attractive systems exist only as prototypes for months after they have been announced. Systems ordered by mail will usually have to be serviced the same way. Any user of a system will occasionally have questions that only someone associated with a manufacturer can answer. The system that is sold and serviced locally and backed by a manufacturer who treats both dealers and owners responsibly will not wind up gathering dust the first time a user has a problem he or she cannot solve without help.

Unless they are relevant to the above considerations, I have little concern for such technical issues as the type of processor, memory chips, or bus structure that a system may use. Price is certainly a major consideration, but the sales price is often deceptive. The cost of a system is not just the selling price but also the expense of adding peripherals, acquiring software, and providing maintenance. Each of these should be investigated carefully before an accurate price comparison can be made.

Finally, I would encourage anyone interested in purchasing a microcomputer for education to realize that selecting and learning to use a classroom system are themselves educational activities. I believe microcomputers are going to bring great change to the process of education, and that only by learning through our own experiences with them will we be prepared to deal wisely with the future that lies just ahead.



COMPUTERS—IN MY CLASSROOM?

How two crusading teachers sold their fellow faculty members and their students on personal computers.

BY WALTER MATHEWS

A growing number of teachers are making personal commitments to the utilization of personal computers in their schools. Getting from that point of individual commitment to realization often requires that teachers become crusaders, convincing other faculty members and school administrators of the need and then leading the way in the acquisition and implementation of a system.

The experiences of two teachers—Bobbie Ferrell in Texas and Bobby Goodson in California—reflect both the frustration and the rewards of becoming "computer advocates" in their schools.

Bobbie Ferrell is with the Greenhill School, a college prep day school in the comfortable Dallas suburb of Richardson, where computers are now popular with students and faculty alike. Getting Greenhill interested in computers was a slow process, however, and it only happened because of the personal enthusiasm of Ms. Ferrell.

After working her way through college as a computer programmer, she joined the Greenhill faculty. That was 15 years ago, and most of those years have been spent trying to get her students to a computer or, since personal computers came on the scene, getting a computer to the students. Along the way she has used some interesting approaches with the faculty, mostly designed to replace their fear of technology with the same fascination she feels for computers.

"Suddenly the problem of getting the kids to a computer was eliminated. Now we can take the computer to the kids."

Turning on the students was the easy part once she could actually get them to a computer.

"During my first year at Greenhill, I taught a course in FORTRAN computer language, but I had to do it without a computer," she said, adding that the students were less than enthusiastic because they couldn't get the hands-on experience needed to bring the lessons to life.

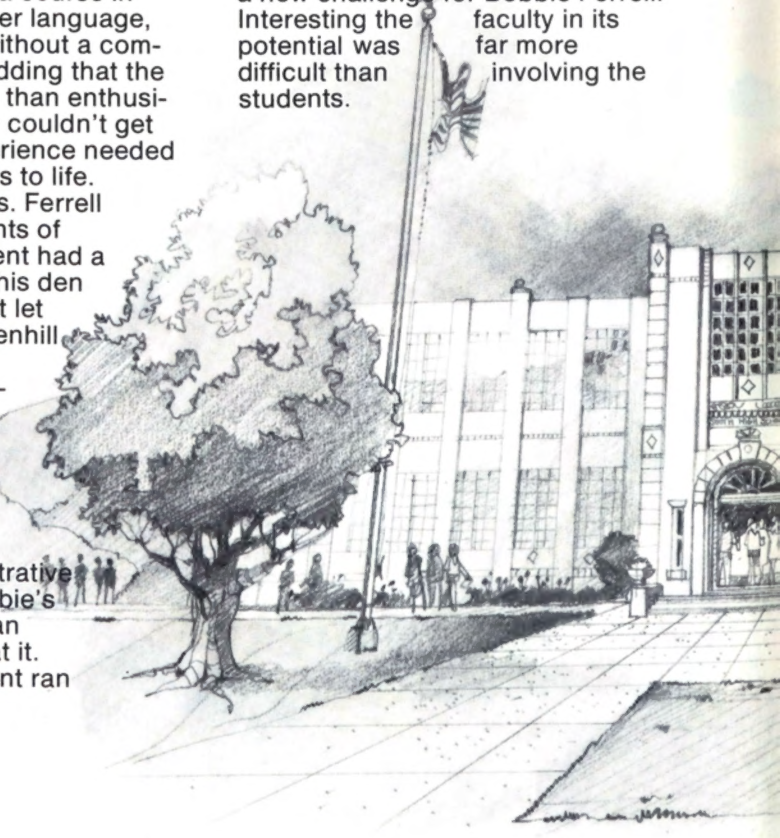
Undaunted, Ms. Ferrell turned to the parents of students. One parent had a large computer in his den and another parent let the students' "Greenhill Computer Club" use his company's computer at night.

Eventually, Texas Instruments donated a 990 computer to the school for administrative purposes, but Bobbie's students also got an occasional crack at it.

"Then a student ran into an Apple computer at a local computer store. We looked at the computer and were very impressed. I got the school to buy two of them, which totally freed the 990 for administrative uses."

"Suddenly the problem of getting the kids to a computer was eliminated," she said. "Now we can take the computer to the kids."

The availability of personal computers on the campus created a new challenge for Bobbie Ferrell. Interesting the faculty in its potential was far more difficult than involving the students.



To overcome this hurdle, Bobbie wrote a special course and put it on audio tape. It described the computer as well as ways in which teachers could incorporate it into their curriculum.

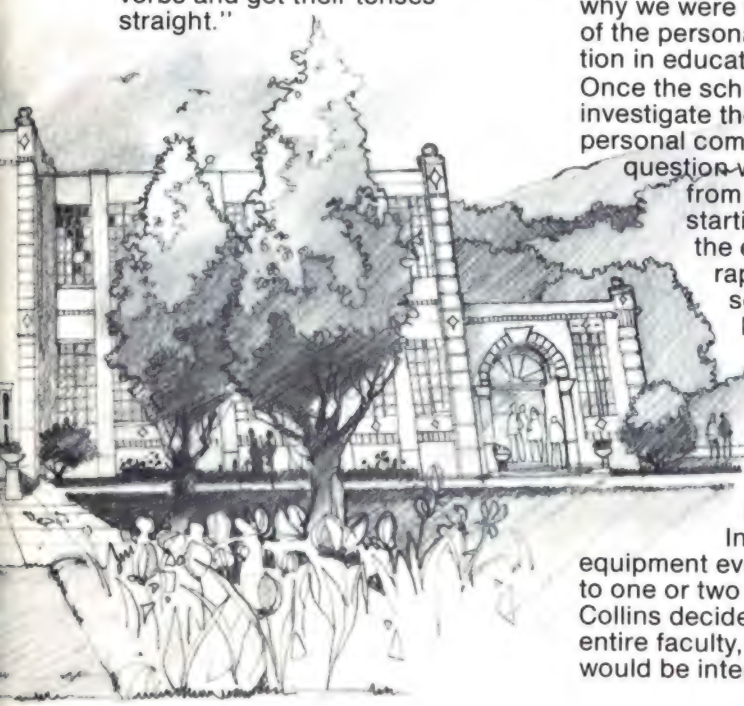
"At the first sign of interest on the part of any teacher, I would encourage them to take the computer and my audio tape home, so they could familiarize themselves with the computer at their own pace."

Once again she was successful and now reports that at least six other faculty members share her excitement for the computer and are using it in the classroom.

Rather than using the computers in classrooms for Computer Assisted Instruction, such as practice and drills, Greenhill puts the emphasis on familiarizing students with computers in general and reinforcing reasoning through learning computer programming.

"We have also seen evidence of the value of computer games as a secondary, rather than a primary, teaching tool. For example, we had an English class in which the students wrote a program that made up funny sentences,such as 'Columbus invented the airplane.'

"As I watched them, I realized that this game was helping them practice a lot of English, because it required them to type nouns and verbs and get their tenses straight."



"Our approach, which was so effective that I recommend it to you if you are faced with the same decision, was to conduct our own 'Microcomputer Faire'"

At Collins Junior High School in Cupertino, California, Bobby Goodson "inherited" her role in turning the school on to personal computers by virtue of being a math teacher who utilized calculator-math in her classes.

The pressure to "go computer" at Collins, according to Ms. Goodson, came partly from a general awareness that other schools were achieving successful results in education with small computers and partly from the community itself. Cupertino is in the heart of Santa Clara County's high-technology industry, which gave birth to the microcomputer, and the community is closely linked to electronics.

"Logically, they began to ask why we were not at the forefront of the personal computer revolution in education," Bobby said. Once the school decided to investigate the utilization of personal computers, the next question was: Where do we go from here? The obvious starting point was with the equipment itself. The rapid growth of personal computers has brought a number of manufacturers into the market, and deciding which one meets your needs is the first big challenge, Ms. Goodson feels.

In some schools the equipment evaluation is often left to one or two faculty members; Collins decided it should involve the entire faculty, so that all of them would be interested in the project and have some understanding of it from the outset.

"Our approach, which was so effective that I recommend it to you if you are faced with the same decision, was to conduct our own 'Microcomputer Faire,'" Bobby said. "We had gathered all the available literature from a number of manufacturers, which only added to the confusion. Personal computers come with a variety of options and price tags, and evaluating them required a demonstration so that we could judge them in action."

She invited four manufacturers to participate, all of them demonstrating their equipment in the same room. It gave the faculty a good basis for comparison, in Bobby's opinion, and allowed them to pick the system they felt would be easiest to expand as their program and knowledge of computers increased.

Soon after Collins purchased their Apple computers, they were funded by an ESEA Title IV C grant for innovation in education, and Ms. Goodson became Project Director.

The school's objectives under the grant are to find the best way to utilize these computers and to report to the government their impact on the students. The funding is for one year and will continue for an additional year if they are successful in showing that the kids really learn more with a computer than without one.

Both Ms. Goodson and Ms. Ferrell agree that any school making the decision to buy a computer should involve the teachers themselves in determining how it can be best utilized.

"The hardware manufacturers, if they listen to the inputs of the teachers, certainly can lead the way," Ms. Goodson said. "But the real answers must come from the teachers themselves."

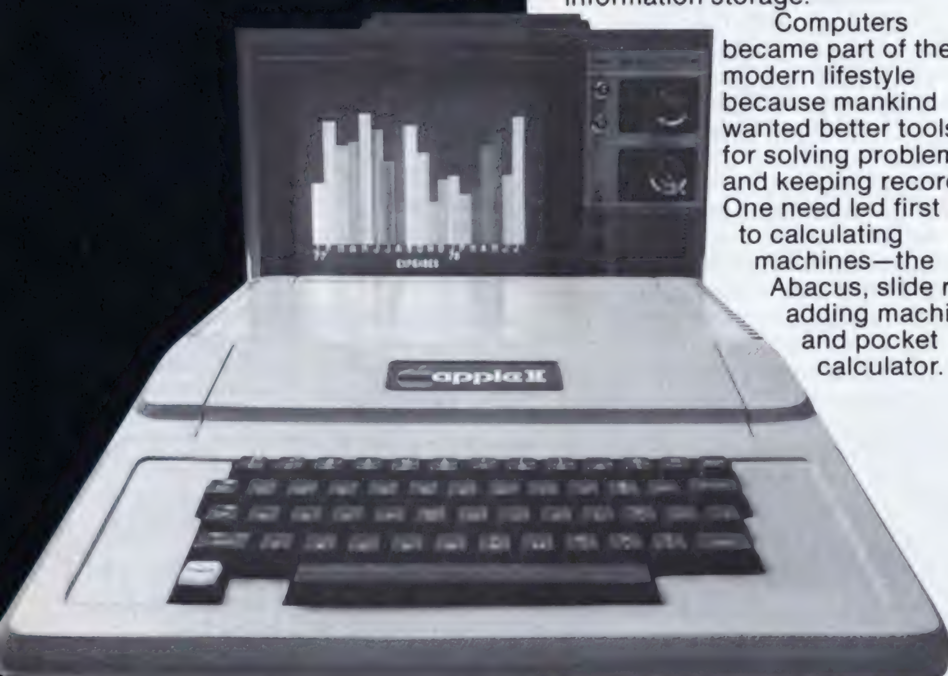
A CONSUMER'S GUIDE TO PERSONAL COMPUTERS

BY GENE CARTER
APPLE COMPUTER INC.

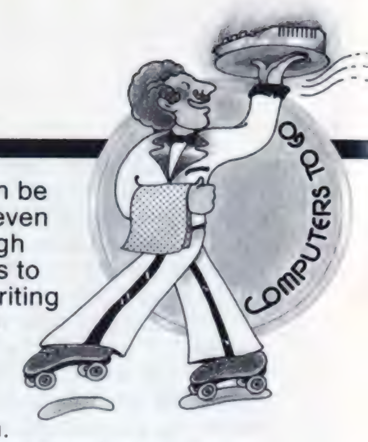
This consumer's guide was written for people in all walks of life. Personal computer users range from persons with no previous technical experience to those with long experience in computer technology. If you are a beginner, don't be intimidated by the technical jargon. Learn from it. Use the guidelines in this article to buy the system that suits your needs now, but also fills your future requirements.

WHAT IS A COMPUTER?

A computer is both a powerful calculator and a system for storing, updating and using information. It solves complex mathematical problems very rapidly. It can also communicate in words and pictures as well as numbers. It can maintain records, control equipment and do many other tasks that require extensive information storage.



Computers became part of the modern lifestyle because mankind wanted better tools for solving problems and keeping records. One need led first to calculating machines—the Abacus, slide rule adding machine and pocket calculator.



The other can be traced back even further through filing cabinets to the picture writing of early civilizations and the notched sticks of primitive man.

The first electronic computer was really a giant calculator named ENIAC (Electronic Numeral Integrator and Calculator). Built in the 1940's with 18,000 vacuum tubes, it filled a large room, consumed 130,000 watts of power, and could be used only by a few experts.

Today's personal computer built with a microprocessor has about five times the computation power of ENIAC, is portable, about 18-inches square, needs about 50 watts of power and can easily be used by all members of a family.

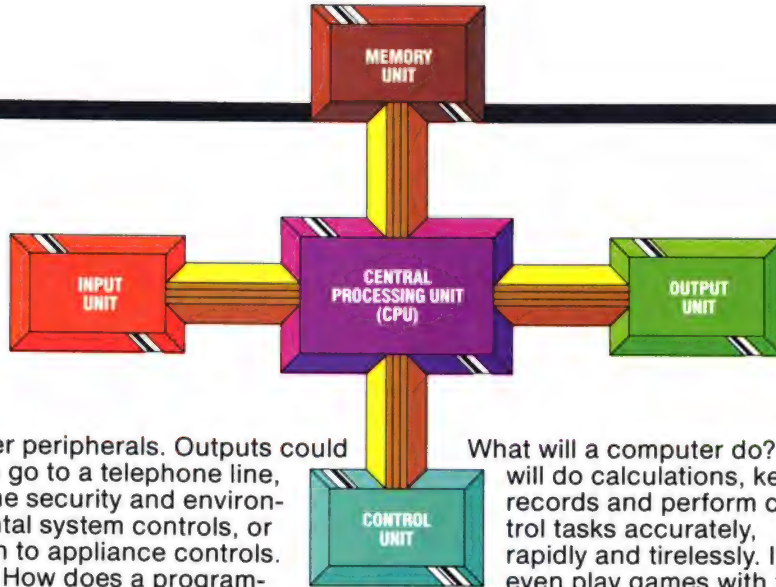
Computers, like some calculators, are programmed—given a series of instructions by the user—to govern their operation. All computers consist of five basic parts. These subsystems are:

1. CPU or Central Processing Unit

The CPU is the "brain" that manipulates all information and performs all calculations.

2. Control Unit

The CPU is controlled by two kinds of programs. "Software" programs are entered by the machine operator, stored in the memory unit and can be changed as often as desired. "Firmware" programs are built into the system, usually in Read Only Memory (ROM) devices that store instructions permanently. Each instruction generally requires several computer operations. The control unit and firmware enable the computer to perform these operations in the right order and at the proper times.



3. Memory Unit

Software programs and data being processed are stored in the memory unit. This memory can be "randomly addressed," which allows the CPU to store and fetch (write and read) data rapidly. For the computer to handle more and more tasks, Random Access Memory (RAM) must be expandable and able to "swap" programs and information with storage peripherals such as tape cassettes and magnetic disk memories.

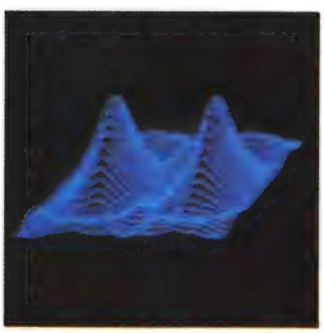
4. Input Interface Unit

Information, control signals, and software enter the computer through this unit, which is attached to a keyboard and other peripherals such as tape cassettes and magnetic disk memories.

5. Output Interface Unit

Results of calculations and processed information go out through this interface to a TV screen, printer, tape cassette, or other peripherals. Outputs could also go to a telephone line, home security and environmental system controls, or even to appliance controls.

How does a programmer communicate with a computer? Think of the computer as another country with its own language. If you went to France for a vacation, you could learn French first or hire an interpreter. A computer programmer can learn to use special "machine languages" or he can use interpreter languages that the computer, itself, translates into instructions. Such interpreters include BASIC, FORTRAN, COBOL, PASCAL, APL., etc. Because BASIC is the most versatile and simplest to learn, it is the preferred language for personal computers.



What will a computer do? It will do calculations, keep records and perform control tasks accurately, rapidly and tirelessly. It can even play games with the children or help you compose and play electronic music. A personal computer is a servant that can save time, educate, entertain, control, and guard your home 24 hours a day. It's used by adults for household management, business and technical work, and enjoyment. It's used by children to learn about computers and to develop mental skills and manual dexterity.

Enjoyment is a major reason for the popularity of programmable computers. You don't need to be a programmer to use them; program libraries are available, and many users also get great satisfaction from developing their own personal programs. Some have even taught their computers to operate with voice commands spoken in plain English!

A good personal computer comes ready to use with a built-in keyboard for input and a program library on tape cassettes. It is connected to an audio cassette recorder for program loading and information storage, and to a TV set for output, as easily as speakers are connected to a hi-fi system. Other peripherals are also easy to connect and the best ones have programming aids that help you become an expert at your own pace.

SELECTING A PERSONAL COMPUTER

The machines on the market today range from cheap units that only use "canned" programs to versatile, high performance, user-programmable systems. You can start sorting them out by defining your needs and planning your applications. With your own needs in mind, your evaluation should cover these important questions:

MANUFACTURER'S REPUTATION

As you would in buying an appliance, check the manufacturer's reputation, look for quality construction, and ask about service. Who can repair the computer and how long will it take? Is there a warranty? How do dealers feel about the manufacturer's business practices? Talk to people who already have personal computers.

EASE OF USE

All computers compute, but each is human-engineered to provide different benefits, so your choice depends upon how you've define your needs. Generally, ease of use comes first. Is the computer easy to set up, operate and program? Can it help everyone who will use it learn how a computer operates? Is it suitable for management tasks like personal inventory, financial planning, mailing lists, and phone directory? Will it meet both business and technical computation needs? Does it have enough memory for your calculations? Can it also serve as an entertainment center?

SYSTEM EXPANDABILITY

Ask the dealer to describe which features meet your initial needs and which can meet your future needs. What comes with the basic computer? Can the memory and interface units be expanded? Is it easy to expand? How do you add peripherals like a printer, typewriter, or disk memory; and accessories like a remote control outlet, voice or music synthesizer and security system? Don't settle for a system that cannot grow with your needs. As any computer owner will tell you, expandability is a *must* because interests and needs will change as you learn more about computer applications.

GRAPHICS? AUDIO?

Most personal computers can put pictures on a black and white TV screen. The better models provide color and sound, too. Can you use color? How many colors? How many dots on the screen? Can you plot at your choice of screen locations? Is there audio output? The uses of audio output include warning the programmer that he has made an error, making interactive games more realistic, generating computer music and alarms.

SOFTWARE SUPPORT

It's not only satisfying to run personally-written programs but also essential for some home and many professional and educational applications. If you want to go beyond a cassette library, ask about languages and other software support. Is the computer programmable in machine language? In BASIC? What kinds of commands and how many commands are available? Does it come in cassette, ROM, or both?

DOCUMENTATION (MANUALS)

Documentation reflects the quality of system design and support. Ask to see *all* manuals and look through them carefully. The technical or "shop" manual should be only the beginning of the user's library. You need a software programming manual with clearly referenced commands and statements, a self-teaching manual on programming methods and documentation on peripheral units.

PERIPHERALS AND INTERFACES

These are two keys to expandability. When comparing peripheral costs, always ask if the peripherals connect directly. If not, ask how much the interfaces will cost. And find out if you have to re-develop your software to use them. Look for a wide choice and don't accept vague promises of "future enhancements." A system with a good selection now will probably have a better one in the future.

These are the major considerations involved in buying a personal computer. Above all, remember that you are buying for the future as well as for today. Plan for growth— yours *and* the computer's.

Gene Carter is Director of Sales for Apple Computer, Inc. Prior to joining the company in 1978, Mr. Carter held various positions in semiconductor and microprocessor marketing and sales. His experience in training salesmen in technology concepts led to writing a primer on personal computers for the consumer.

Personal Computer CHECK-OFF List

A shopping list will help you make a fair comparison between APPLE II and other personal computers when you get to the computer store. Read through the check-off list that starts below, mark the items that fit your family's needs and make an item by item comparison at the store. For the name of the nearest Apple Computer dealer call (408) 996-1010 in California or 800-538-9696 toll free.

Brand A	Brand B	Apple II	
			Warranty and Servicing
		✓	1-year limited warranty
		✓	Service readily available
		✓	Plug-in boards and components for fast, low cost service
			Computer Electronics
		✓	One cabinet holds all electronics and interfaces
		✓	Power supply with output sufficient to power complete system expanded to 48 kilobytes of Random Access Memory (48K RAM), 12 kilobytes of Read Only Memory (12K ROM) and 8 peripheral interface and accessory cards
		✓	Keyboard with quality feel of office typewriter and N-key rollover that virtually eliminates speed related typing errors
		✓	Single-board computer construction
			Easy, on-board expansion of memory—user or dealer installable
		✓	• Random Access Memory—4,096 to 48 kilobytes (4K to 48K RAM)
		✓	• Read Only Memory to 12 kilobytes (to 12K ROM)
		✓	Peripheral interface and accessory cards plug into eight connectors for easy expansion of system input/output capability
		✓	15-color output to standard color TV using inexpensive modulator
		✓	High speed cassette input/output interface to any standard audio cassette recorder. Program loading time is only 20 seconds per 4,096 bytes of program or data.
		✓	Audio speaker built-in to enhance both program writing and game playing
		✓	Four inputs for using four game paddles (two game controls supplied) or for connecting thermostats and other resistor type sensors.
		✓	Seven single input/output lines for connecting touch switches and other on-off sensors and for controlling relays, lights or other devices
			System Software and Programming Aids
			BASIC language built-in. Two BASIC interpreters are supplied. An education BASIC utilizing integer arithmetic is resident in ROM. An extended floating point BASIC with 9-digit precision and scientific notation for scientific and business applications is supplied on tape, diskette, or as an optional ROM accessory card.
		✓	• Integer BASIC has 56 easy to use commands, statements and arithmetic operators.

Brand A	Brand B	Apple II	
		✓	• Extended floating point BASIC has 116 commands, statements, arithmetic operators and transcendental functions.
			Resident Monitor with mini-assembler and disassembler to facilitate machine language programming included
			Special interactive communications features like:
		✓	• Complete cursor control—up, down, forward, backward
		✓	• Automatic line numbering capability
		✓	• Software selectable scrolling window, split-screen capability
		✓	• Letter, word or line delete, edit or copy capability
			Special graphics capabilities like:
		✓	• 15-color display in a 40 × 48 array of dots
		✓	• 6-color display in a 192 × 280 array of dots
		✓	• Ability to plot any point in array with a simple PLOT X, Y command
			Built-in speaker that provides:
		✓	• Audible warning of a programming syntax error
		✓	• Human engineering of programs by adding audio tones and even synthesized speech for impact and interactive response
		✓	• Music composition
			Special BASIC programming commands like:
		✓	• PDL (x) for direct command of game paddle I/O port
		✓	• IN # x and PR # x for direct command of the eight input/output accessories and peripheral connectors

Applications Software

Brand A	Brand B	Apple II	
			Financial, business and scientific programs
		✓	• DOW JONES* Investment Manager's Series, including: ——Stock Quote Reporter—for current Wall Street prices (delayed 15 minutes) ——Portfolio Evaluator—calculates portfolio value, long and short-term gains/losses *In cooperation with Dow Jones and Co., Inc.
		✓	• Home Money Manager's Series, including: ——Checkbook–an accounts payable data base manager ——Basic Finance–computes parameters and provides amortization schedules for savings, loans, and leases
			Education programs
		✓	• Hangman—a spelling quiz program
		✓	• Color Math—a flash card math quiz
		✓	• Mastermind—a color guessing game for logical thinking development
		✓	• Routines for drawing high resolution graphics shapes
			Entertainment programs
		✓	• Slot Machine
		✓	• Blackjack
		✓	• Star Wars
		✓	• Star Trek
		✓	• Breakout
		✓	• Biorhythm
			Other sources of programs
		✓	• *Some Common BASIC Programs,* Osborne and Associates—a book of business, statistics, mathematics and engineering programs. These programs run in APPLESOFT II
		✓	• *101 BASIC Computer Games,* Creative Computing—most of these games will run in APPLESOFT II
		✓	• *What to Do After You Hit Return,* Peoples Computer Company—a book of programs that will run on the APPLE II
		✓	• Magnemedia, Inc.—extensive library of educational programs that run on APPLE II

Brand A	Brand B	Apple II	
			USER Contributed Software
		✓	• Apple Software Bank Contributed Software Library—a rapidly-growing library of programs for business, scientific, entertainment, and educational purposes
			Documentation
		✓	*Programming Manual.* Over 100 pages of step by step, self-teaching procedures on "how to program" in BASIC for the beginner
		✓	*Basic Language Reference Manual.* Over 170 pages describing how to use the floating point BASIC language and a listing of all commands, operators and statements with syntax examples
		✓	*System Reference Manual.* Includes hardware description, software description, firmware description, detailed schematic diagram and general information on most aspects of the computer
		✓	*Microprocessor Manuals.* Complete documentation on how to design and program with the 6502 CPU at the component level is provided in 6502 Hardware Manual and Programming Manual
		✓	*Technical Descriptions.* Each peripheral interface has a Technical Product Description and Instruction Manual
			Intelligent Peripheral Interfaces and Accessories
		✓	*All APPLE II Intelligent Interfaces have built-in programs that eliminate the need for loading a cassette or writing a routine into your program to drive the peripheral. Each peripheral is addressed with simple BASIC commands for input and output control such as PR # x to output or IN # x to input.*
		✓	*Hobby Prototyping Board (A2B0001)*—board for custom interface designs has 100-mil-grid hole pattern for wire wrapping or soldering
		✓	*Parallel Printer Interface (A2B0002)*—interface for most standard parallel input printers such as Centronics, Selecterm, Anderson Jacobson, Axiom, etc.
		✓	*Communications Interface (A2B0003)*—RS232C modem interface for telephone line data communications at 110 or 300 baud data rates (half or full duplex). APPLE II will operate as a computer or as an intelligent terminal in a distributed processing network with this board installed
		✓	*High Speed Serial Interface (A2B0005)*—RS232 serial interface to high speed printers, plotters and other instruments with standard RS232 interfaces operating half duplex. Data transmission rates are selectable from 75 to 19.2K baud
		✓	*Mass Memory Floppy Disk Subsystem (A2M0004)*—one 116K-byte drive with interface that also interfaces second 116K-byte mini-floppy disk drive, giving you expansion to 232K bytes per controller
		✓	*APPLESOFT II—BASIC Firmware Board (A2B0009)*—peripheral board containing APPLESOFT II, the 10K extended floating point BASIC language. Is switchable between business/scientific BASIC and education BASIC. Plugs into peripheral card slot.
		✓	*PROGRAMMERS AID # 1 (A2M0012)* Plugs into ROM socket on computer board and provides the following functions:
		✓	• Program renumber/append
		✓	• Tape verify
		✓	• High resolution graphics
		✓	• Musical tone generation
		✓	• Machine language program relocation
		✓	• Memory test diagnostics

glos-sa-ry

JEF RASKIN'S BRIEF DICTIONARY OF COMPUTERESE

Accessories Items which enhance the utility of a possession. They help satisfy the urge to go out and buy something new when you're not in the mood for a major purchase. See PERIPHERAL.

Acoustic Coupler A form of modem which permits attachment of an ordinary telephone handset so that a computer can communicate over any telephone. See MODEM.

Acronym A word made from the initial letters of a phrase. In the early days of computing many experts spent as much time forming clever acronyms as programming. They are a bit out of fashion today. See BASIC.

Alphanumeric A character that is a letter or a numeral. See SPECIAL CHARACTER.

Analog Where you are just before you fall off the log. Seriously, an analog device uses a physical quantity, such as length or voltage, to represent the value of a number. The now obsolete slide rule was an analog calculator, where length along a piece of wood or plastic represented numerical quantity.

Analog Input A *continuously variable quantity* (such as the position of a knob or joystick) which the computer can convert into numbers that can be used by a program. Analog input is used in many game playing programs. See INPUT.

Analog Output A voltage or other physical quantity which the computer can produce, proportional to a number generated by a program. Controlling a robot with a computer is an example of using analog output. Another example would be a music synthesizer.

Apple 1. The round firm fleshy fruit of a Rosaceous tree (Pyrus Malus). 2. A British recording company that specialized in sounds made by certain insects. 3. A retractile force, opposite in nature to a push.

Array A list of numbers of strings (or other entities in more sophisticated systems), elements of which can be referred to by their position in the list.

ASCII Acronym for American Standard Code for Information Interchange. Computers use a numerical representation for letters, numerals, and special characters. This standard specifies which number will stand for each character. All personal computers use this standard.

Assembler A program that translates assembly language into the *computer's native language*.

Assembly Language A low-level language that is similar in structure to the *computer's native language* but is more convenient to use. See native language.

BASIC A quaint little language used by humans to tell computers what they are supposed to do. The word "BASIC" is an acronym for "Beginners All-purpose Symbolic Instruction Code." It can be used with almost all personal computers and is extremely popular. BASIC (which should always be written in capital letters) was invented by Kemeny and Kurtz at Dartmouth College in 1963.

Baud A measure of the speed with which information can be communicated between two devices. If the information is, for example, in the form of alphabetic characters, then 300 baud usually corresponds to about 30 characters per second. An average typist types at about 100 baud, and President Kennedy could read at 20,000 baud. Technically, it is the number of bits transmitted or received per second.

Binary A system of numbers where each digit stands for a power of two. In the usual decimal system each digit stands for a multiple of a power of 10. For example, the decimal number 1908 means one thousand plus nine hundreds, (the zero indicates no tens) plus eight. In binary, where every digit is either a zero or a one, the number 1101 means one eight, plus one four, (the zero indicates no twos) plus one.

People once had to use binary numbers to program computers. Fortunately that is no longer the case, and understanding binary numbers is not crucial when using a personal computer.

BIT The smallest amount of information that can be known. A single bit can specify either of two alternatives. In computerese, the term "bit" usually refers to the concept behind the words from which it was invented: "BInary digiT", meaning either a one or a zero. A bit can be thought of as representing a simple yes/no choice, or as representing the distinction between true and false, or as representing whether a circuit is on or off—or any other two-way choice.

Branch Normally, a computer executes the statements of a program in order of appearance. Statements that tell the computer to break out of this normal mode are said to cause a branch. In BASIC, one such statement is a GOTO.

Bug An error. A hardware bug is a malfunction or design error in the computer or its peripherals. A software bug is a programming error. See FEATURE.

Bus (or Buss) The means used to transfer information from one part of a computer to another.

Byte Technically, eight bits (very rarely: some other number of bits). In practice, a byte is usually used to represent an alpha-numeric character or a number in the range 0 to 255.

Central Processing Unit Usually referred to as the "CPU." See CPU.

Chip 1. A small (typically less than half a centimeter on a side and quite thin) piece of material (usually silicon) into which have been formed from a few dozen to tens of thousands of circuit elements. This is done by etching the material, depositing microscopic metal conductors, and selectively impregnating ("doping") the material with various elements that change its properties. See INTEGRATED CIRCUIT. 2. The integrated circuit that houses a chip. This is a somewhat colloquial usage and should be avoided.

Code 1. Computerese for something written in a computer language, as in the statement "She wrote some pretty tight code." "Code" usually refers to machine-language programming. It is the kind of slang used by hackers. See HACKERS. 2. Occasionally used in its usual sense to indicate a different method of representing text. See ASCII.

Command A request to the computer that is executed as soon as it has been received. Sometimes this word is used interchangeably with the terms "instruction" and "statement." Those terms properly refer to portions of programs and not to commands which are carried out immediately. See INSTRUCTION.

Compiler A program that translates one computer language into another. Most commonly the term refers to a program that translates a higher level language into the computer's native language.

Computer Any device that can receive and then follow instructions to manipulate information. In any computer, both the set of instructions and the information on which the instructions operate may be varied from one moment to another. A device whose instructions may not be changed is not a computer.
The distinction between a programmable calculator and a computer is that the computer can manipulate text as well as numbers, whereas the calculator can only handle numbers.

Computerese A peculiar dialect spoken and written by computer initiates for the gratification of their egos. See ENGLISH.

Concatenation In computerese, the process of joining two strings to make a longer string.

Control Characters Characters or commands obtained by holding down the key marked "CTRL" while pressing another key on a keyboard.

CPU The abbreviation of "Central Processing Unit," an absolescent term for that portion of the computer which controls peripherals and memory. The CPU was once a separate part of a computer but the term has lost its usefulness in personal computers where it refers to a tiny portion of one of the chips in the machine.

CRT Abbreviation for "Cathode Ray Tube," but in practice it is computerese for a television set, or any television-screen type of display.

Cursor A symbol placed on the screen to let you know where the next character you type will appear.

Data Information of any kind. Often the idea of numerical information is implied.

Debugging Finding errors and correcting them.

Digital Used in computerese to describe information that can be represented by a collection of bits. See BIT. Most modern computers store information in digital form.

DIP Acronym for "Dual In-line Package," the most common physical form for an IC which has two rows of leads that look somewhat like the legs of a caterpillar. See INTEGRATED CIRCUIT.

Disassembler A program that translates a computer's native language into assembly language.

Disk (Disc) A circular piece of material which has a magnetic coating similar to that found on ordinary recording tape. Digital information can be stored magnetically on a disk, much as musical information is stored on a magnetic tape. This term is often (and confusingly) used also to refer to a disk drive. See DISK DRIVE.

Diskette A small floppy disk in a square plastic envelope commonly either about 13 or 20 cm on a side. See FLOPPY DISK.

Disk Drive A peripheral which can store information on and retrieve information from a disk. A floppy disk drive can store information from a floppy disk, and can retrieve that information. See DISK.

Document noun: A written description of a piece of software or hardware.
verb: To produce such a description.
Production of good documentation is a sure sign that a programmer is not a hacker. See HACKER.

DOS Acronym for "Disk Operating System"—a collection of programs which facilitate use of a disk drive. It is pronounced "de-oh-ess" or "doss."

Editing Making corrections or changes in a program or data.

English The proper language to be used between English speaking people to describe computers and how they work. See COMPUTERESE.

Execute To do what a command or program specifies. To run a program or portion of a program.

Expression A combination of variables, numbers and operators that can be evaluated to a single quantity. For example, if R has the value 8 then the numerical expression 4 * (R − 3) evaluates to 20. There are also expressions involving quantities other than numbers (e.g. strings) in some computer languages.

Feature A bug as described by the marketing department. See BUG.

Firmware Software entombed in a ROM. See SOFTWARE, also see ROM.

Floppy Disk A small inexpensive disk, called "floppy" since it is made from flexible materials in distinction to "hard" disks which are made from rigid materials. See DISKETTE.

Format verb: To specify the form in which something is to appear.
noun: Such a specification.

Hacker A person who likes to play with computers, usually to the exclusion of all other activities. These creatures are often asocial, and their greatest joy is creating a program which makes a fellow hacker ask "How the hell did you get the computer to do that?"
Unfortunately, as a species, they are useless as programmers since ordinary mortals will not be able to use any program they create.

Hard Copy Information printed on paper or other durable surface. This term is used to distinguish printed information from the temporary image presented on the computer's CRT screen.

Hardware The physical parts of a computer. See SOFTWARE.

IBM Card See PUNCHED CARD.

IBM Machine Obsolescent term for "computer." It properly refers to anything made by International Business Machines, but the term used to be a generic appellation for computers since IBM used to make such a large percentage of them.

IC See INTEGRATED CIRCUIT.

Increment The oppcsite of excrement. Really: in computerese it means to add one to a counter. If X has the value 5 and you increment X, it will then have the value 6. Occasionally the term increment will mean to add some quantity other than one. In these cases a phrase such as "increment by 3" will be used, or you will know from context that some other quantity is meant.

Initialize 1. To set up the starting conditions necessary for the execution of the remainder of a program. For example, in a program that draws a circle, the initialization might include specifying the radius of the circle. 2. To prepare a diskette so that the computer can later store data on it.

Input Information arriving at a device. Consider that, from a cow's point of view,milk is output, while it is input from a calf's point of view. Hence the very same data moving around in a computer system will be output one instant (from one part of the computer) and input the next instant (to some other part of the computer). You must be careful when using the terms input and output to specify what they are input to or output from.
The word "input" is sometimes used as a verb, even though it feels a bit strange to do so. For example: You must input the data before doing the calculations. SEE OUTPUT.

Instruction The smallest portion of a program that a computer can execute. The term is used with a number of other less clearly defined meanings. Its meaning in such cases parallels its usual meaning in English: a statement directing something to perform an action. See PROGRAM.

Integrated Circuit Usually consists of a plastic or ceramic body from 1 to 5 cm in length, from 1 to 2 cm in width, and typically 2 or 3 mm thick with from 4 to 40 (rarely more) metal leads extending from it. It is usually called an "IC" (pronounced eye-see). Inside the body is a chip (SEE CHIP). The body protects the chip, and the leads allow electrical connection of the chip to other components.
The term "chip" is often incorrectly used to refer to the entire IC.

Interactive Said of a computer system which responds to the user quickly—usually less than a second for a typical action. All personal computer systems are interactive.

Interface 1. The electronics that allow two different devices to communicate with one another. 2. More generally, any situation where two different entities (e.g. a person and a computer) communicate.

Interpreter A program that allows a computer to directly execute instructions and commands in a computer language which is different from the computer's native language. See NATIVE LANGUAGE and COMPILER.

I/O Abbreviation for Input and/or Output. A keyboard, a floppy disk drive and a printer are all I/O devices.

Iterate To repeatedly execute a set of instructions.

Iteration See LOOP.

K Stands for "Kilo," which means one thousand. In computerese 1K is usually used to mean 1024 but sometimes stands for 1000. (And you thought that computer hackers liked to be logical and consistent.) A "computer with 32K bytes of memory" usually means that the computer has 32 times 1024, which is 32768, bytes of memory.

Keyword or Key Word A word that has meaning in a computer language. See RESERVED WORD.

Language In computerese, a language is a set of conventions specifying how to tell a computer what to do.

Loop See ITERATION.

Love An infantile human disorder to which computers are as yet immune.

Machine Code Programming in *MACHINE LANGUAGE*.

Machine Language The native language of a particular computer. See NATIVE LANGUAGE.

Memory The portion of a computer which stores information. See ROM and RAM.

Menu A list of options from which to choose.

Micro Computerese for quite small.

Microcomputer A computer based on a microprocessor.

Microfiche A guppy.

Microprocessor An integrated circuit that performs the task of executing instructions. The presence of a microprocessor in a product does not make it into a computer.

MODEM An abbreviation of the words "MOdulator-DEModulator." It is a device that allows a computer to communicate over the telephone lines (and other communication media). It does this by changing the digital information into musical tones (modulating) and from musical tones to digital information (demodulating).

Modulator A device that lets a computer use any ordinary television set for output. This term is understood in this sense mainly with respect to personal computers as such modulators are not generally used with larger machines. It is sometimes referred to as an RF modulator. RF stands for "Radio Frequency," meaning Television Broadcasting Frequency. Such is life.

Monitor 1. A television set. Often one that is specially manufactured to be connected to a computer. 2. A program supplied by the manufacturer that allows the user to control the operation of a computer. With computers that operate directly in a higher level language, such as BASIC, the monitor may often be built into the language.

Native Language The language that a computer was built to understand. This language is usually rather inconvenient to use. Thus, most computers are provided with other languages as well.

Null String A string consisting of no characters whatever. If it doesn't seem like a useful idea, think about how useful the number zero is.

Operator 1. A symbol that represents a mathematical operation, such as addition, division, comparison or exponentiation, to name a few. 2. In the old days, a specialist who knew how to operate a computer. They usually wore white lab coats.

OS An acronym for "Operating System" (pronounced "Oh Ess"). An OS is a collection of programs which allege to aid a person in controlling a computer. This term is usually used in reference to large computers. A small computer operating system is often called a monitor. See MONITOR.

Output Information leaving from a device or process. For example, the output from a computer can be displayed by a printer or CRT. This term can also be used as a verb, even if it does sound a bit awkward, as in: Watch the computer output a graph. See INPUT for a more elaborate discussion.

Paper Tape An obsolescent means of storing information by punching holes in a strip of paper. Devices for handling paper tape are usually large, noisy and slow. Besides, what do you do with all those little circles of paper once they're punched out?

Parallel In computerese, two or more things happening at the same time. A parallel interface is one that controls a number of distinct electrical signals simultaneously. See BUS. Contrast with SERIAL.

Peripheral A device that can send information to and/or receive information from a computer. Some typical peripherals are: floppy disk drives, printers, modems, television sets.

Personal Computer A general purpose computer that is inexpensive enough to be owned by an individual with a moderate income.

Port That portion of a computer through which a peripheral may communicate. Sometimes sloppily confused with INTERFACE since almost all ports are associated with interfaces.

Precedence Rules that state which operators get executed first in an expression. For example, by the usual rules of precedence 3+4*2 is 11 rather than 14 since multiplication has "higher" precedence than addition and is done first.

Prime Number The most tender and most juicy kind of number, as certified by the U.S. Department of Agriculture.

Printer In computerese: a peripheral that makes hard copy of letters and numerals. A line printer prints a whole line of text at a time. A serial printer prints one character at a time.

Program A sequence of instructions that describe a process. A program must be in a language that a computer can understand.

Programmer A person who writes and documents programs.

Prompt A symbol that appears on your computer's display to let you know that it is ready to pay attention to your commands.

Punched Card An obsolescent means of storing information by punching holes in a small sheet of cardboard. Creates litter.

RAM Acronym for "Random Access Memory." This is the main memory of any computer. Information and programs are stored in RAM, and they may be retrieved or changed by a program. For some computers, the information in RAM is lost whenever the power is turned off.

Random Number Generator A program that, when executed, provides a number whose value is difficult to predict. In many computer systems a random number generator is built into the language rather than appearing as a subroutine.

Reserved Word A word that you cannot use as a variable name, since it has been pre-empted for use in the computer's language. You also may be restricted from using reserved words in other ways as well. Key words are often reserved words. See KEY WORD.

ROM Acronym for "Read-Only Memory." This is a kind of memory in which the information is stored once, usually by the manufacturer, and cannot be changed. Programs such as a BASIC interpreter, that are used by nearly all owners of a computer, are often stored in ROM.

Save To store a program somewhere other than in the computer's memory, for example on a diskette or cassette tape.

Screen 1. A surface on which information is displayed, such as a TV screen. 2. The sound you make when a program refuses to work for the seventeenth time.

Scroll To move all the text on the screen (usually upwards) to make room for more text (usually on the bottom).

Semantics In computerese: the meaning of an instruction or program, i.e. what it is supposed to do.

Serial Things occurring one after the other. A serial interface is one that sends out one bit at a time. See PRINTER for another use of the term.

Software Programs. Sometimes "software" refers to programs and data.

Special Character A character that can be displayed by the computer, but is not a letter or numeral. Here are some special characters:
^ ¯!"#$%&'()−=[{]}\|@`;+:*,<.>/?

Statement An instruction.

String A sequence of letters, numerals and other characters. See NULL STRING.

Subroutine A portion of a program that can be executed by a special statement. In BASIC, that statement is "GOSUB." This effectively gives a single statement the strength of a whole program. The subroutine is a very powerful construct, often underexploited by novice programmers.

Syntax The rules that specify exactly how an instruction can be written.

Teletype A noisy, slow and obsolescent terminal that may include facilities to handle paper tape.

Terminal The condition of a computer just before it dies. Actually: A peripheral, consisting of a keyboard through which a person can send information to the computer and a printer or screen through which the computer can present information to the person.

Text In computerese, this word means data other than numbers.

Users' Group An association of people who all have an interest in a particular computer or group of computers. They usually meet to exchange information, share programs, trade equipment, and show off their accomplishments.

Variable A name for a quantity. A variable in a computer language can be thought of as a box into which a value may be stored. Such values are, typically, numbers and strings. More sophisticated systems may allow the value of a variable to be a picture, an array or some other structure.

Window A portion of the computer's display that is dedicated to some special purpose.

Epilogue to this Dictionary *The exact extent of almost any word in any language is a bit fuzzy. For example, the word "text" might be applied to a program when it is being edited, but would not be used for the same program when it was being executed. The definition of words is not fixed in time either. This dictionary was written in 1978, and in a fast-moving technology words change with alarming rapidity. New words and meanings come along daily. Nobody can learn to speak a language with a dictionary alone. If they try, they sound like a foreigner to those in the know. This short glossary of computer terms is only an aid to your "inputting" the words of others. It is of almost no use if you wish to "output" in computerese.*

NEW LEARNING AIDS OFFER HELP FOR THE HANDICAPPED

BY PAMELA JUNG

Nowhere are the benefits of learning with personal computers more dramatic than with the handicapped, whose physical limitations have been a barrier to an education.

The small computer, coupled with an assortment of specially designed input and output techniques, can become a "voice" for those who have none, "eyes" for those who are sightless, and "ears" for the deaf.

In many cases the design of these special learning aids is being accomplished by individuals who feel the need personally—they are relatives or friends of handicapped people.

Three such individuals—all working independently with cerebral palsy victims—are John Giem, Tim Scully and John Watkins. The experiences of these three California men serve to illustrate the flexibility of the personal computer and,hopefully, will inspire others to envision new ways of helping the handicapped to communicate and learn.

JOHN GIEM is an engineer whose son, Chris, has cerebral palsy. Out of his son's needs, Giem envisioned a system in which a "joy stick" could be used to control the interface with a computer, thus eliminating the need for a keyboard, often one of the greatest obstacles for the handicapped.

Giem enlisted the aid of an occupational therapist and a counsellor who trains handicapped people to be computer programmers. By pooling their ideas and expertise, they have designed a microcomputer system that is flexible, reliable, and inexpensive enough to be offered to the entire physically handicapped community.

The system involves an easily-maneuvered stick control which lets the user build sentences on a TV screen through simple movements either to the right or left.

In the case of his son, Giem said, this new ability has removed the frustration of trying to control the movements of a pencil when writing.

The developers of the system said the same basic approach will work for the blind if an audible feedback is added to the computer so that the user can build sentences by sound.

Further refinements will make it possible for persons with movement in only one direction to use a one-movement joy stick, for those who are almost completely paralyzed to operate the system with only their tongue, or for quadraplegics to be able to use nothing but voice commands to control the computer.

"The biggest thrill was watching her face the first time she spelled out on the screen 'My name is Dawn.'"

Indeed, making this system possible for a wide range of handicapped people is the primary objective of John Giem and his co-workers.

At a future point, they hope to be able to do away with the menu of characters that must now be shown on the screen for the construction of sentences.

"What I envision," said Giem, "is that when a person wants to write a book report, the screen will be taken up by complete pages of sentences rather than just a sentence at a time. The person can then edit and format each page in its entirety and store it on a floppy disk for retrieval at any time.

"The system, complete with a two-movement joy stick and audible feedback is almost complete now, and we hope to have it available to the handicapped community by next year."

JOHN WATKINS, a computer salesman whose daughter is a victim of cerebral palsy, also was convinced that a personal computer was the answer to her problems in communicating and learning, but encountered the very real fact of her inability to use a standard keyboard.

Watkins' solution was to custom design an oversized touch sensitive keyboard, measuring 15″ × 18″, with "keys" which are really flat surfaces measuring 1″ square and with 1″ of spacing between them in all directions.

"This allows a large target area which makes it possible for the handicapped person with limited finger dexterity to be able to touch the appropriate area," Watkins said. "Using the prototype I've built, my daughter is now able to produce letters and numbers on a TV screen with just the slightest touch."

Watkins conceived the keyboard with virtually no idea as to how it could be produced until he read about a new California electronics company, TASA, Inc., which had developed a low-cost flat-surface keyboard using all solid state circuitry. He took his idea to the company, which is now in the process of implementing the design.

The results with his own daughter have been impressive, he said. "The biggest thrill was watching her face the first time she spelled out on the screen 'My name is Dawn.'" Watkins is now making plans to market the system for other handicapped users, either as a complete package with a microcomputer or with a TV interface which makes it usable with any microcomputer.

"Using a two-channel tape recorder, a personal computer and educational tapes, I've been able to provide Dawn with an expandable learning center and a means to store homework, games, stories, and so on. I would like to see the parents of other handicapped children have the same opportunity," Watkins said.

TIM SCULLY is perhaps the most publicized of the three men covered in this article. His work, like that of John Giem, has been detailed at the West Coast Computer Faire and Scully has attracted added attention because he is doing his design work from inside the walls of a Federal prison, where he is serving out a drug-related sentence.

The cerebral palsy victim with whom Scully worked was a friend in her twenties who can't talk or use her hands and has only limited control over one knee. When he met her in 1976, she was communicating via an electric word wheel to help her in "talking," since she was able to read and understand speech. She was able to trigger the word wheel with her knee and stop it when it rotated to the letter or phrase she wanted.

Scully designed a system incorporating a personal computer and video display to replace the word wheel, providing the girl, Robin, with a greater vocabulary stored in the computer memory.

The system, which has been installed on Robin's wheelchair, is operated with a kneeswitch which allows her to select from the menu of items on the TV display.

According to Scully, the system has opened new horizons for Robin, who had lived her 20-plus years without the ability to do things as simple as asking for a drink of water.

In the case of all three of these special projects involving cerebral palsy victims, there clearly are potential applications to help other handicapped persons.

Similar efforts are underway worldwide either by concerned individuals or organizations, all aimed at providing help to the handicapped, regardless of what that handicap might be, in communicating with the world around them.

And with that expanded communications ability, the personal computer can provide new learning opportunities for the handicapped far beyond their present limitations.

New input approaches, such as this TASA touch-activated keyboard, will expand the usefulness of personal computers to the handicapped.

STUDENTS + COMPUTERS = LEARNING.

BY JEF RASKIN

There have been too many attempts in recent years to "package" and "sell" education. The message "education is fun" has been shouted at students by many educators and by TV sets tuned to educational programs which try too hard to be "fun."

They forget that everyone has a deep, natural desire to learn. Personal computers show promise of capitalizing on that natural desire because they are good for learning.

Some educators have called personal computers overrated, when in truth they are being used badly and the real learning involved goes unobserved. An example of this is the proud parent who brings home a personal computer and writes or runs a program to do arithmetic drill. The program might be dressed up with color and sound: a smiling face and a short tune when the answer is right, and a frowning face and a buzz when the answer is wrong. The child is almost guaranteed to be delighted with the new toy and, to be sure, any drill the child does with the computer will improve his or her arithmetic ability a smidgen. But a drill is a drill, and as soon as the child discovers that it's the same old routine in a new package, he or she won't find it so attractive.

In truth, playing games that the learner enjoys on the computer probably teaches as much as many programs designed to be "educational," such as number drills.

Educators refer to it as "metalearning," from the Greek word meta, meaning "along with." It means simply that a child learns on at least two levels when operating a computer. Obviously, there is the overt learning, such as "3 times 9 equals 27" in an arithmetic problem. But then there is also the deeper and more subtle learning that comes from operating the machine itself. In working with a computer, a child learns to be more organized, systematic and logical as his or her deductive reasoning power increases. Also, most importantly, the child learns that in reality the machine is only as smart as you make it, thus destroying the myth of the "intelligent, human-like" computer.

Any consideration of computers and education should include a look at the actual study of computers and programming (called "computer science"), as well as the use of computers to teach other subjects (called "computer assisted instruction" or CAI).

I have considerable experience teaching computer science to a varied audience, and it is clear from my experience that it is far easier to teach on a small computer than on a large one. When I first saw the APPLE II, I thought it was the best tool for teaching programming that I had ever seen.

What the APPLE II can do better than any other computer now in production (at a reasonable cost) is to *motivate* the student.

The ease of producing good-looking color graphics, as well as sound can entice almost anyone into trying their hand at programming. And if the color and sound don't catch your interest, the real time interaction that is possible through paddle commands (for writing Paddle and Ball programs) will. A few students will be interested (and fewer still excited) to write a program to produce a list of random numbers. But almost any student will be fascinated by the display produced by:

```
10 GR
20 COLOR = RND(16)
30 PLOT RND(40),RND(40)
40 GOTO 20
```

It is easy to communicate, starting with this simple program,

---

__Jef Raskin__ is now manager of publications and applications programming for Apple Computer. Prior to joining the firm at the end of 1977, he had been with Bannister & Crun, a California company producing computer documentation. Jef, who also is author of the Apple II BASIC programming manual, spent several years on the faculty of the University of California at San Diego, where he was director of the Third College Computer Center.

the concepts of loop, random generator, co-ordinates, and functions. It is possible to start the discussion with immediate execution of the COLOR and PLOT commands.

Very simple programs can produce extraordinary complex designs using color graphics. When numeric or even alphabetic output is produced, simple programs tend to produce simple results. At the beginning of a course on programming I was always concerned because the results of the initial programs were so trivial. The students occasionally lost interest in a device that seemed to require so much effort for so little return. With APPLE II, the reward is immediate.

Education need not only proceed inside the classroom. Personal computers are affordable, and individuals are learning by themselves at home. Nothing could please an educator more. I am convinced that most people learn a great deal by playing with "toys" (anything from a bag of building blocks to a 90-foot yacht).

All teachers have seen students who seem not to remember any three items taught in class, yet who could reel off the names and batting averages (as well as other trivia) about a hundred or more baseball players. The difference, of course, is that the student is *interested* in baseball, and the facts were communicated away from the school atmosphere. That's why I look forward to seeing personal computers in the schools and am even happier still to see them in homes.

A very real benefit in having a computer connected to the family television set is that it makes the passive "boob tube" a center for active interaction between members of the household. Children and adults play games together, help each other in solving problems, and even compete to see who can draw the most colorful, intricate pictures on the screen.

I hope that most parents are smart enough not to force their computers on their children but will enjoy the computers themselves. The children will inevitably become interested if the parents are and, if there is no pressure put on them, will learn how to program the "toy" themselves.

Teaching subjects other than computer programming is another matter entirely. Typing and some arithmetic (as well as some mathematics and electronics) can be motivated directly by the computer. Other subjects are introduced by programs that are written for the purpose. Computer Assisted Instruction is, all too often, merely automated drill. It can be better, particularly if problem-solving dialogue with the computer are included along with the drills.

At present, students use the computer as an aid in solving a problem by inputting an arithmetic or algebraic expression or by writing a computer program directing the computer to solve the problem. Future developments CAI will see the microcomputer engaging in dialogue with the student, presenting large bodies of information and optionally querying or being queried. The computer will then analyze the student's remarks and gauge the student's comprehension of the material, sometimes suggesting the need for additional study.

"Education need not only proceed inside the classroom. Personal computers are affordable, and individuals are learning by themselves at home. Nothing could please an educator more."

Instruction in noncomputer areas is best instilled by means of games. A game such as "Hangman" will improve the player's sensitivity to word construction in English. Simulations, such as some versions of "Hammurabi," give some insight into the functioning of large economic or political systems. A badly-done simulation teaches poorly, and a good implementation teaches well.

Many schools across the country already have discovered the value of this form of learning. For example: in Sunnyvale, California school, 5th and 6th grade students are learning programming from their instructor, Robert Albrecht, so that they can teach other children. They are performing computer simulations such as "Whale Watching," in which they help a migrating gray whale make the right decisions to reach breeding grounds in Baja California.

High school students in Lexington, Mass. have written their own program to simulate the Apollo moon landing, which makes it necessary for them to learn about gravitational effects and Newton's laws of motion well enough to bring the space ship back to a safe landing.

Junior high school and senior high school students in the Colorado Springs Unified School District are using 16 computers to learn BASIC programming, a reward for which is being able to conduct simulations in biology, physics and social science.

Students in my own classes have used computers to write poetry and music, design windmills and bicycles, do astronomical tables, analyze writing style, simulate medical diagnoses, calculate genetic influences, and simulate animal behavior. In doing each of these projects, the students came to view more carefully their primary subject area.

Using a computer also teaches patience and humility. Nothing makes you feel humble like have a computer inform you, by doing *exactly* what you told it to do, that you haven't said exactly what you thought you did. This happens to even the most expert programmers.

With the personal computer children from the age of 18 months and up can have a "toy" whose limitless growth matches their own. If you wonder what an 18-month-old child can do with a computer, just write a program that puts up a screenful of color and makes a different sound each time any key is hit.

The personal computer will change the nature of education. It's starting now. Some applications will further stultify the educational process, and others will enhance and enliven it.

And no matter what educators do, the best learning about computers will happen by itself, while people are having fun.

apple II personal computer system

APPLE II C-1/C-2
PERSONAL COMPUTER SYSTEM

APPLE II C-3/C-4
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APPLE II

PERSONAL COMPUTER SYSTEM

APPLE II will change the way you think about computers. That's because it is specifically designed to handle the day to day tasks of education, financial planning, building security, scientific calculation, and entertainment. APPLE II is appealing and comfortable (like other appliances that make your life easier); and it brings to personal computing a new level of simplicity through hardware and software sophistication.

GETTING STARTED

APPLE II is faster, smaller, and more powerful than its predecessors. And it's more fun to use too, because of advanced, built-in features like:

- BASIC — The Language that Makes Programming Fun
- Fifteen-Color Standard Graphics (in an 1,880-Point Array) for Spectacular Visual Effects
- High-Resolution Graphics (in a 54,000-Point Array) for Finely-Detailed Displays
- Loudspeaker and Sound Capability that Brings Programs to Life
- Four Hand-Control Inputs for Games and Other Human-Input Applications
- Internal Memory Capacity of 48K Bytes of RAM, 12K Bytes of ROM; for Big-System Performance in a Small Package
- Eight Accessory Expansion Slots to let APPLE II Grow With Your Needs

You don't need to be an expert to use and enjoy APPLE II. It's a complete, ready-to-run computer — not a kit. Connect it to your color TV* and start writing programs the very first day. Become familiar with BASIC, using the 125 page Programming Manual. You'll gain deep satisfaction and a feeling of accomplishment as you learn to create color games and artistic displays; or instruct APPLE II to chart your home finances. Controlling the computer is easy using its familiar, typewriter-style keyboard and conversational BASIC language.

*APPLE II plugs directly into a TV monitor or hooks up to any standard television using an inexpensive commercially-available RF modulator (not supplied).

SAY IT IN COLOR

APPLE's advanced graphics commands make brilliant, effective, color displays something even a beginner can master. And the usefulness of color extends far beyond entertainment. Multi-color charts and graphs can "humanize" your programs for greater interest and comprehension.

High-resolution graphics can take you even farther. APPLE's 54,000-point color display lets you explore applications ranging from architectural design to fingerprint analysis. And you can label your diagrams with upper/lower case characters, Greek letters or special symbols. You can even define your own unique character sets.

SOUND ADDS A NEW DIMENSION

APPLE II speaks for itself. In STAR WARS, you'll actually hear the phasers fire through a built-in speaker. And you can create your own music under computer control. But synthesized sound is more than a toy. Audible cues announce system functions or programming errors, so you don't have to watch the TV monitor to see what's happening. In your own programs, tones add life to games and presentations.

HAND CONTROLS INCLUDED

Up to four rotary hand controls and three pushbuttons connect directly to APPLE II (two of each come with the computer), and are used with simple BASIC commands. They assist in applications ranging from "ball and paddle" games to graphic design, where the operator interacts with figures on the screen.

USER PROGRAM-MABLE

A fast, powerful integer BASIC is built into APPLE II. It lets you write complex programs, and generate spectacular color graphics displays. For business and scientific programming, Applesoft Floating-Point BASIC provides an extensive library of mathematical and character-handling functions, as well as 9-digit precision in arithmetic calculations.

The built-in assembler, disassembler and monitor will be appreciated by advanced programmers in search of more speed or flexibility than BASIC can provide.

A LEARNING TOOL

APPLE II is a portable education. Using it, you'll begin to learn what a computer is all about. You'll discover how easy it is to create programs that help your kids with arithmetic or spelling. (Yes, it's OK to let your kids use APPLE II. It's ruggedly engineered and has a virtually unbreakable molded case.) You can save those programs on an ordinary cassette recorder, or on the optional floppy disk subsystem. As your skill grows, your library will too. And you will enjoy expanding that library in future years through your local Apple users group or from the rapidly growing Apple Software Bank.

APPLE GROWS WITH YOU

APPLE II was designed to grow with you, so we built in expandability at the start — with a hefty power supply and eight interface card slots right on the system circuit board. You can synthesize music, print mailing labels, control AC receptacles, or talk to another computer; all just by plugging in a card. And the best is yet to come, as new Apple hardware and software options appear on a monthly basis this year.

AND YET...

APPLE II is simple on the outside. Like a TV set or an automobile, it is sophisticated enough to be easy to use. But as you gain experience with it, you'll grow to appreciate the sophistication inside. It shows up in features like the built-in assembler, disassembler, utility routines, and monitor; a switching power supply that runs cool without fans; and a circuit design so trouble-free that we warrant it for one full year.

Introduce yourself to APPLE II — the advanced personal computer that's a tool for today, and a continuing challenge for years to come.

Simplicity. Sophistication. APPLE II

APPLE II
TECHNICAL OVERVIEW

APPLE II is a complete, self-contained, ready-to-use computer based on the 6502 microprocessor. Standard features include BASIC, assembler, disassembler, and monitor in ROM; color graphics, sockets for up to 48K bytes RAM, cassette interface, Apple game I/O connector, typewriter-style ASCII keyboard, high-efficiency switching power supply and rugged structural foam case. Also included as standard are: demonstration cassette tapes, two game controls, and detailed Reference and BASIC Programming manuals.

VIDEO DISPLAY

The APPLE II video circuitry displays memory as text, color graphics, or high-resolution graphics — software selectable. Both graphics modes can be selected to include 4 lines of text at the bottom of the display area. In either graphics mode the user can select (under software control) one of two memory pages to be displayed. The standard Apple provides an NTSC composite video output.

TEXT

- 40 characters/line, 24 lines
- 5 x 7 upper-case characters
- Normal, inverse or flashing characters
- Extensive display control software in ROM
- Full cursor control —protected screen feature
- Fast display — 1000 cps

COLOR GRAPHICS

- 40h x 48v resolution (40h x 40v with 4 lines text)
- 15 colors — color generated digitally
- BASIC commands to use graphics easily

HIGH RESOLUTION GRAPHICS

- 280H x 192V resolution (or 280V x 160V with 4 lines text); 6 colors—black, white, violet, green, blue, orange
- Displays 8K bytes

MEMORY

RAM is organized into 3 increments of 16K bytes each. Memory may be easily expanded by inserting an additional increment of chips. Up to 48K bytes of RAM can be contained on the single board. 8K bytes of ROM (supplied) store Apple BASIC (6K) and a powerful system monitor (2K). Two additional ROM sockets are provided for future Apple software.

- Up to 48K bytes on-board RAM — no peripheral memory boards
- Unique automatic RAM refresh system, completely transparent
- Uses 4116 or 2117 type 16K RAMs
- Fast memory—350ns access time

I/O

APPLE II includes as standard an ASCII keyboard, audio cassette interface, 8 peripheral board connectors, speaker, game I/O connector and two game controls.

- Reliable, typewriter-style keyboard
- Fast cassette interface — 1500 bps
- Peripheral board connectors
  — Fully buffered, with interrupt and DMA priority structure
- GAME I/O — 4 paddle inputs, 3 TTL inputs and 4 TTL outputs

BASIC

Apple BASIC is a fast, translated integer BASIC that includes the following features (in addition to normal BASIC capabilities):

- Any-length variable names (ALPHA, BETA$)
- Syntax and range errors indicated immediately when entered
- Multiple statements on one line
- Integers from -32767 to +32767
- String arrays to 255 characters; Single-dimension integer arrays
- Graphics Commands: COLOR = expr; PLOT X,Y; HLIN X_1, X_2 at Y; (draw horizontal line), VLIN Y_1, Y_2 at X; SCRN(x,y) (reads the screen color)
- Paddle read function: PDL(0-3)
- TEXT and Graphics Commands to set display mode from BASIC
- Immediate execution of most statements
- Break and Continue program execution
- Debug commands: line number trace and variable trace
- Switchable I/O device assignments
- Direct memory access: PEEK, POKE, CALL, POP commands
- Cassette SAVE and LOAD commands
- Auto line number mode
- RND, SGN, ASC, LEN and ABS functions
- GOTO expr, GOSUB expr allowed
- Fully interruptable

MONITOR

- Simulated single-step and trace modes; Breakpoint handling
- Disassembler and single-pass assembler
- Input/Output device assignment
- Editing on keyboard entry
- Register examine/modify
- Read/Write cassette routines
- Hex add/subtract for relative branch calculations

All U.S. (NTSC) APPLE II systems are identical except for the amount of RAM supplied. Systems include Applesoft BASIC on tape, with documentation. PAL and SECAM-compatible versions of APPLE II are available through Eurapple (international operations of Apple Computer) in Cupertino, Ca.

APPLE II PAL/SECAM, 220V

Apple II is equipped with a 110V, 50/60HZ power supply and NTSC (U.S. television system) video interface. Most countries require a 220V power supply and use the PAL or SECAM color television system. The Apple II PAL/SECAM has been developed for use in these countries.

The Apple II PAL/SECAM differs from the Apple II in its timing and color generation circuitry. Applesoft, the high-resolution graphics software, the disk drive, the graphics input tablet, the communications card, and the serial card have been modified to reflect these differences. Apple II PAL/SECAM has the same specifications as the Apple II except for the following:

- Power supply: 220/240V, 50/60HZ
- High resolution graphics: 360 dots horizontal × 192 dots vertical
- Video output: direct PAL color interface
- SECAM through an interface card in slot 7

ORDERING INFORMATION

U.S. Order No.	RAM	PAL/SECAM Order No.
A2S0016	16K bytes	A2S0016E
A2S0032	32K bytes	A2S0032E
A2S0048	48K bytes	A2S0048E

APPLE INTELLIGENT SUBSYSTEMS

DISK II FLOPPY DISK SUBSYSTEM

GENERAL DESCRIPTION

Many computer applications depend upon rapid access to information. The home computer balancing a checkbook and the business computer managing inventory share this need. To provide for fast, low-cost data retrieval, Apple Computer, Inc. has developed Disk II.

Disk II simplifies the approach to your program library. No longer must you search through stacks of cassettes or slowly read yards of tape to find the program you want. Now, with a few keystrokes, your system will find and load any file by name. And it will do it quickly and reliably.

Disk II gives your system immediate access to large bodies of data. That makes inventory, address file, and recipe programs suddenly feasible. It means you can store a year's worth of financial records in one place, and sort through them quickly. And it allows you to handle many other applications that just were not practical before.

The Disk II Floppy Disk Subsystem consists of an intelligent interface card, a powerful Disk Operating System (DOS), and one or two mini-floppy drives. (The computer will handle up to seven interface cards and fourteen drives, for control of nearly 1.6 megabytes of data). The combination of ROM-based bootstrap loader and an operating system in RAM provides complete disk handling capability.

FEATURES

- Powerful Disk Operating Software:
  - — LOAD and STORE files by name (Up to 35 Char/Name)
  - — BASIC Program Chaining
  - — Random or Sequential File Access
- Fast Access Time — 600msec (Max.) Across 35 Tracks
- Individual File Write-Protection Eliminates Accidental File Alterations
- Full Disk Capability in Systems with as Little as 32K RAM
- Data Transfer Rate of 156K Bits/sec
- Storage Capacity of 116 Kilobytes/Diskette
- High-Efficiency Subsystem Powered Directly from the APPLE II (Up to 14 Drives)
- Completely Assembled and Tested — Not a Kit
- Packaged in Heavy-Duty, Color-Coordinated Steel Cabinet

USING THE DISK II FLOPPY DISK SUBSYSTEM

The Disk II Subsystem allows your Apple to manipulate program and data files through simple BASIC statements. Command interpretation and file handling are controlled by software automatically loaded into RAM as the disk is initialized.

A BASIC statement such as PR#7 activates the Disk Subsystem. The CATALOG statement will then display a list of the files contained on a particular diskette. Other commands allow the user to Write-Protect a file, READ or WRITE it, and SAVE it back on the disk.

As data is stored on the subsystem, it is automatically put into unused sectors of the disk, which are linked together until a space of adequate size has been created to hold the new file. Thus the user gets the most efficient utilization of his disk area, yet does not have to know the maximum size of each file in advance.

Files stored on the disk can be copied, deleted, or renamed under program control. The CHAIN command permits the chaining together of multiple BASIC programs. And EXEC allows the creation of command streams that can be executed from the disk.

The Disk II Operating System fully supports both Applesoft and Floating-Point BASIC Integer BASIC through its universal command handler. All commands are completely explained in the manual supplied with Disk II.

SPECIFICATIONS

PARAMETER	DESCRIPTION
Commands:	OPEN, CLOSE, READ, WRITE, LOAD, SAVE, EXEC, RUN, APPEND, LOCK, CHAIN, UNLOCK, DELETE, MONITOR, NOMONITOR, MAXFILES, IN#, PR#, INIT, BLOAD, BSAVE
Access Method:	Random or Sequential — arbitrary record length
Bootstrap Loader Method:	By means of Loader routine in two 256 x 8 PROMs, on-card
Disk Drive:	Shugart 5-1/4" floppy disk.
Track Access Time:	Varies with number of tracks crossed. 200msec (avg.), 600msec (max. accross 35 tracks)
Disk Speed and Latency:	300 rpm, 100 msec avg. latency
Disk Capacity:	116K bytes (formatted), soft-sectored
Data Transfer Rate:	156K bits per second
Physical Dimensions:	Card — 4.5" x 2.75" (not including connector fingers): fits inside the APPLE II Drive — 6.1" x 8.75" x 3.8" (WDH)
Controller Capacity:	Up to two drives per controller. Multiple controllers can be used

ORDERING INFORMATION

Order Number: A2M0004 (U.S.), A2M0004E (PAL/SECAM). Supplied with:

- Floppy Disk Interface Card
- Bootstrap in ROM
- Disk Drive and Connecting Cable
- System Software on Diskette
- Manual
- Blank Diskette

Order Number: A2M0003 (U.S.), A2M0003E (PAL/SECAM). Supplied with:

- Second Disk Drive and Connecting Cable

APPLE INTELLIGENT INTERFACES

PARALLEL PRINTER INTERFACE CARD

GENERAL DESCRIPTION

Printer Interface Cards open up a wide range of printing applications for the APPLE. With these cards (and most popular printers) you can produce the reports, labels, and listings your application requires. And, because these interfaces are intelligent, they help you use all the capabilities built into your printer. Expanded headlines, lower-case text, graphics—if the printer can do it, you can now program it simply and quickly, in BASIC. No complex control software to write or load.

Two versions of the Parallel Printer Card are available. Model A2B0007 is specially designed for use with Centronics matrix printers. It comes with the appropriate cable, connector and jumper blocks and special control commands are built right in. (This card is included with Centronics printers purchased from Apple.) Standard model A2B0002 is for use with Axiom, Printronix, SWTP, Selectric conversions, and most other printers that accept 7- or 8-bit parallel data from the computer. Universal cable and jumper blocks are easily customized to a particular printer following detailed instructions supplied in the Parallel Printer Card Manual.

FEATURES

- No Programming Needed—Built-in Firmware Allows Printing With Simple BASIC Commands
- Prints up to 255 Char/Line—Upper/Lower Case, Special Symbols, etc.
- High Speed—up to 5000 Char/Sec (3700 LPM @ 80 Char/Line)
- Easy to Use with Most Popular Printers (Axiom, Centronics, SWPP, Selectric conversions), Featuring Parallel Data Input
- Fully Assembled—Ready to Plug In and Use

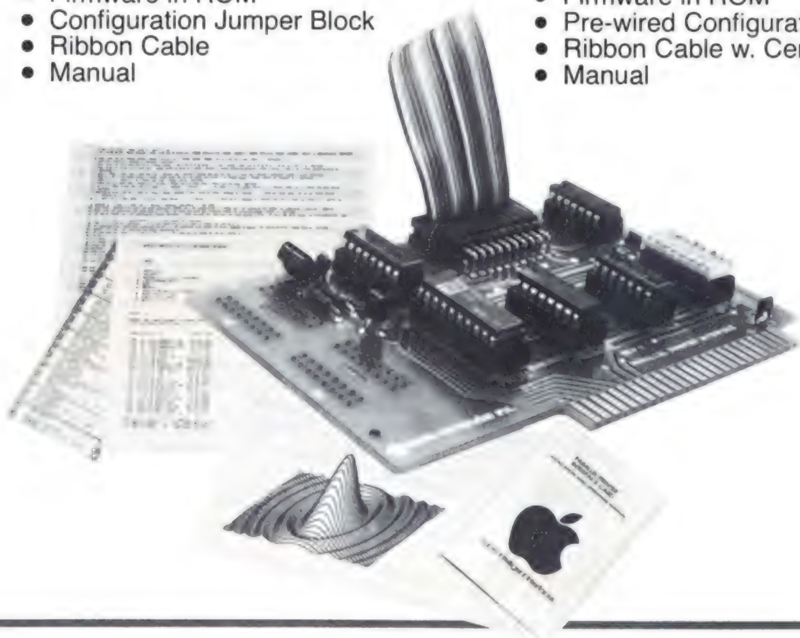
SPECIFICATIONS

PARAMETER	DESCRIPTION
Data and Control Signals:	8 Data bits, STROBE and ACKNOWLEDGE (positive or negative-going)
Power Consumption:	5V @ 150mA
Print Line Width:	40-255 Char/Line. Automatic formatting of BASIC listings
Printing Speed:	Up to 5000 char/sec, printer controlled
Printer Connection:	By means of 20-wire ribbon cable, included (user must supply connector on printer side of cable, except with Centronics Card A2B0007)

ORDERING INFORMATION

Standard Card: A2B0002 Supplied with:
- Firmware in ROM
- Configuration Jumper Block
- Ribbon Cable
- Manual

Centronics Card: A2B0007 Supplied with:
- Firmware in ROM
- Pre-wired Configuration Jumper Block
- Ribbon Cable w. Centronics Connector
- Manual



APPLE INTELLIGENT INTERFACES

SERIAL INTERFACE CARD

GENERAL DESCRIPTION

The Serial Interface Card allows APPLE to exchange data with computers, printers and other devices in serial format (one bit at a time). In the printer mode, it can produce charts, reports and labels on most popular serial printers. It is intended for use (in place of the Communications Interface Card) in applications that:

- Involve serial printers or terminals;
- Use data rates other than 110 or 300 baud (10 or 30 char/sec); or
- Require movement of large data blocks (256 or more bytes) without interruption

The Serial Card features on-board firmware that provides BASIC control in both block-data-transfer and printer-operation modes. A number of hardware and software switches on the card serve to adapt it to a wide variety of applications, yet it remains simple to use because of its built-in intelligence.

FEATURES

- Permits BASIC Control of High-Speed Printers and Plotters
- Quickly Transfers Large Blocks of Data by Telephone (through a modem), or Directly to Local Equipment
- Includes Control Software in ROM — No Programs to Write
- Handles Half-Duplex Communication from 75-19.2K Baud
- Provides Switch-Selectable Preset Conditions for Speed, Line Length, Auto Line Feed and Carriage Return Delay
- Provides an RS-232C or Current Loop Serial Interface
- Fully Assembled and Tested—Ready to Plug in and Use

SPECIFICATIONS

PARAMETER	DESCRIPTION
Signal Level:	EIA RS-232C
Data Word Format:	1 start bit, 1 or 2 stop bits, 5-8 data bits; odd, even, or no parity; Checksum is optional.
Character Handling Options:	Lower-case characters can be optionally converted to upper-case or can be passed through unmodified and displayed in inverse video on the monitor screen.

ORDERING INFORMATION

Order Number: A2B0005 (U.S.), A2B0005E (PAL/SECAM). Supplied with:

- Firmware in ROM
- DB-25 Connector and Mounting Bracket
- Manual

APPLE INTELLIGENT INTERFACES

COMMUNICATIONS INTERFACE CARD

GENERAL DESCRIPTION

The Communications Interface Card extends the usefulness of your APPLE by allowing it to tap the immense resources of timesharing services and the telephone network itself. Now (using a modem) you can exchange programs over the phone lines; send messages to remote terminals through a timesharing network; or access your office computer from the comfort of your home. And best of all, because this card is intelligent, you can do all these things quickly and easily, in BASIC. There are no control programs to write or load.

FEATURES

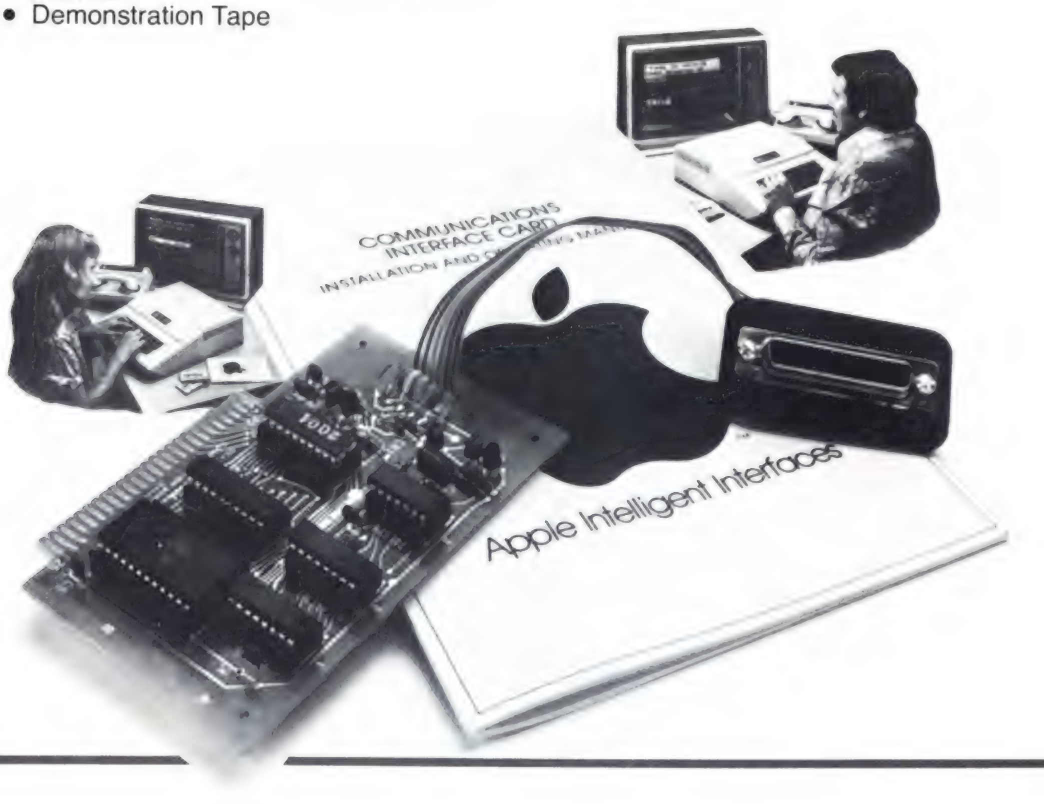
- Permits Distributed Computing Using Two or More APPLEs
- Quickly Transfers Letters, Programs, or other Information over the Phone Lines Through Standard Modems or Acoustic Couplers
- Allows the APPLE to Become a Terminal for other Computer Systems
- Includes all Necessary Programs—No Software to Write
- Easily Controlled from BASIC using Simple Commands
- Communicates at 110 or 300 Baud, Half-or Full-Duplex
- Provides an RS-232C Serial Interface
- Fully Assembled and Tested—Ready to Plug In and Use

SPECIFICATIONS

PARAMETER	DESCRIPTION
Signal Level:	EIA RS-232C
Data Word Format:	1 start bit, 1 or 2 stop bits, 7 or 8 data bits; odd, even or no parity
Lower-Case Characters:	Can be optionally converted to upper-case, or can be passed through unmodified.
Power Consumption:	5V at 150mA (max.)

ORDERING INFORMATION

Order Number: A2B0003 (U.S.), A2B0003E (PAL/SECAM). Supplied with:
- Firmware in ROM
- DB-25 Connector and Mounting Bracket
- Manual
- Demonstration Tape



APPLE INTELLIGENT SUBSYSTEMS

GRAPHICS INPUT TABLET

GENERAL DESCRIPTION

The Graphics Input Tablet opens up unique new applications by simplifying the input of graphic information from:

- Maps & Photos
- Histograms
- Schematic Diagrams
- Architectural Renderings

Using the tablet and stylus, one merely traces any series of shapes to convert them into digital information. This data can then be stored, manipulated, and displayed by the APPLE. The 11″ × 11″ active tablet area allows large and complex figures to be entered easily, with a resolution of 200 points per inch.

Sophisticated programs supplied with the tablet allow stored images to be translated, rotated, and magnified for display. Line segments can be created by specifying their endpoints, so that accurate lines can be hand drawn. Area calculations can be performed on the resulting figures. In both text and graphics modes, a video cursor follows the stylus position. This simplifies image generation, and allows stylus selection of commands, shapes, and patterns from a menu or template at bottom of the page.

FEATURES

- Dramatically Simplifies Production of Complex Images
- Eliminates Tedious Hand Calculations of Graph Coordinates And Figure Dimensions
- Allows Rotation, Translation, And Magnification of Created Images
- Coordinated Cursor Allows Stylus Selection From Command Tables or Shape Templates on Tablet
- All Functions Supported From BASIC
- High Resolution For Detailed Figures—200 Points/Inch
- Fully Assembled and Tested—Ready to Plug In and Use

SPECIFICATIONS

Unit consists of external digitizing tablet and plug-in interface card.

PARAMETER	**DESCRIPTION**
Tablet Size:	15″ square (11″ square active area), ½″ high
Image Resolution:	200 points per inch, vert. & horiz.
Power Consumption:	5v @ 150mA (from APPLE supply)
Input Modes:	Continuous or upon command

ORDERING INFORMATION

Order Number: A2M0029 (U.S.), A2M0029E (PAL/SECAM). Available 1H '79.
Supplied with:

- Input Tablet, Interface Card, Connecting Cable
- Manual
- Control Firmware in ROM
- Image Manipulation Software Package on Tape

APPLE INTELLIGENT SUBSYSTEMS

INPUT/OUTPUT DEVICES

For the user's convenience, Apple Computer has assembled a family of compatible products that enhance the usefulness of the APPLE II.

PRINTER II (Centronics MICROPRINTER-PI)

This compact, desk-top printer employs electric discharge technology to print up to 80 characters per line at 150 lines per minute. The printer produces 5 x 7 dot-matrix characters at 5, 10, or 20 characters per inch. It prints the full 96-character ASCII set, including lower-case letters. It is quiet and reliable, and uses no toner or ribbon. It prints on 4.75", aluminum-coated roll stock. The printer is supplied with a Parallel Printer Interface Card, all necessary cables and connectors, and operating documentation. (Order No. A2M0010)

PRINTER IIA (Centronics 779)

The 779 is a medium-speed impact printer for home and business applications requiring low-cost, multi-copy printing. It prints 132 (5 x 7) dot-matrix characters per line, at 60 characters per second. This printer is capable of reproducing the 64-character, upper-case ASCII set; and its tractor paper feed allows printing of five-part forms in widths to 9.8". The mechanism is packaged in a low-profile, desk-top cabinet. Printer IIA is supplied with a Parallel Printer Interface Card, all necessary cables and connectors, and operating documentation. (Order No. A2M0011)

MONITOR II

This 9-inch (diagonal) video monitor is the ideal display for the APPLE II when color output is not required. It sits neatly on top of the computer, and provides a very clean and sharp picture. It accepts direct video input from the system, so no modulator is required. Monitor II comes complete with all necessary cables, connectors, and documentation. (Order No. A2M0005)

SPEECHLAB™ VOICE RECOGNITION UNIT (Heuristics 20A)

This plug-in module allows the APPLE II to recognize a spoken vocabulary of up to 32 user-selected words. The computer can be programmed to perform any task desired upon recognition of a key word. This product is well-suited to both entertainment and serious research uses; and has great potential in applications for the physically handicapped. The Voice Recognition Unit comes as a plug-in card, with a microphone and complete documentation. (Order No. A2M0015)

AC LINE CONTROL UNIT (Mountain Hardware Introl™)

This product allows the APPLE II to remotely switch any AC device ON or OFF. It operates by sending control signals through a building's AC power lines to up to 64 adapters located at outlets throughout the structure. Each remote adapter will switch and sense the status of two independent, 500-watt outlets. Installation is entirely by means of plug-in modules, so no re-wiring is required. Complete isolation from the AC line means there is no danger of shock or short-circuit. With full documentation. (Master Controller Plus Dual Channel Remote—Order No. A2M0012) (Dual Channel Remote Adapter—Order No. A2M0013)

TAPE RECORDER

A tape recorder is the basic program and data storage mechanism for the APPLE II. This one offers the convenience of pushbutton operation; and it runs from either batteries or the AC line. (Order No. A2M0017)

MODEM IIA

Modem IIA is an acoustic coupler which links the APPLE II (through the Communications Interface Card) to the telephone network. The modem is a 103A-type asynchronous device, suitable for data communication at 110 or 300 baud (10 or 30 char/sec). It operates in either the Originate or Answer modes. Connection to the phone system is accomplished by placing the telephone handset in position on top of the modem. No permanent connection or wiring changes are required.

Modem IIA is supplied with a Communications Interface Card, demonstration tape, all required cables, and complete documentation. (Order No. A2M0018-U.S., A2M0018E European)

APPLE DOCUMENTATION & ACCESSORIES

SYSTEM DOCUMENTATION

All APPLE computers come with complete documentation for users at every level of technical expertise.

APPLE II BASIC PROGRAMMING MANUAL

This manual starts from the beginning with how to plug in the APPLE. It then guides the user's first programming efforts. A humorous style and abundant examples make this the ideal textbook for newcomers to personal computing.

(Order No. A2L0005, 125 pages. Supplied with APPLE systems)

APPLE II REFERENCE MANUAL

This manual addresses the details of the system: hardware schematics, firmware listings, special system features, and use of the monitor. It is aimed at the user who is comfortable with BASIC and wishes to become familiar with the advanced features of the APPLE II.

(Order No. A2L0001, 151 pages. Supplied with APPLE systems)

APPLESOFT REFERENCE MANUAL

This manual introduces Applesoft, an extended BASIC language for business and scientific applications. It is written for the user who has some familiarity with the BASIC language.

(Order No. A2L0004, 170 pages. Supplied with APPLE systems)

6500 μP HARDWARE MANUAL

This manual is directed at the hardware designer who wants detailed information about the 6502 microprocessor used in the APPLE II. (Order No. A2L0002, 165 pages)

6500 μP PROGRAMMING MANUAL

This manual addresses the internal structure and assembly language programming of the 6502 microprocessor. It assumes that the reader is moderately familiar with computer concepts. (Order No. A20003, 239 pages)

CLOCK/ CALENDAR CARD

This plug-in card provides a 388-day calendar and clock, with resolution (to 1/1000 second). The clock is crystal controlled to yield .001% accuracy. A built-in rechargeable battery keeps the clock on time up to four days without system power, and external batteries may be used for longer periods. Optional interrupt capability simplifies control applications. Order Number: A2M0024. Supplied with complete operating instructions and rechargeable battery.

HOBBY/ PROTOTYPING CARD

Creat your own APPLE interface boards with this wire-wrap card. The 2¾" × 7", double-sided circuit board includes a hole pattern (on 100-mil centers) that accepts all conventional IC's and passive components. It plugs directly into any APPLE expansion connector, and fits entirely within the computer case. Order Number: A2B0001. Supplied with complete bus documentation to aid the interface designer.

APPLE SOFTWARE BANK

SYSTEM FIRMWARE OPTIONS

APPLESOFT II FLOATING-POINT BASIC LANGUAGE

Applesoft II is an expanded version of Microsoft's popular floating-point BASIC. Its 9-digit arithmetic and large function library make it ideal for business and scientific programs. New features like high-resolution graphics routines, cassette data STORE/RECALL, and user-programmable error messages make the language both powerful and easy to use. Capabilities include:

- 3 Data Types — Real, Integer, and String
- Data Display in either Fixed-Point or Scientific Notation
- N-Dimensional Arrays and N-Letter Variable Names (first two letters significant)
- Extensive Mathmetical, Logical and Scientific Capabilities
  - EXP, LN, SQ.RT., SIN, COS, TAN, ARCTAN
  - AND, OR, NOT, ABS, INT, RANDOM, SIGN
- String Operatings to Aid the Business Programmer:
  - Compare: =, >, <, >=, <=, ><
  - Concatenate: +
  - Variable Type Conversion: ASC, STR, VAL
  - Substring Separation: LEFT, RIGHT, MID, LEN
- Graphics Statements that Simplify Display Programming:
  - Print Format Control: NORMAL, INVERSE, FLASH
  - Graphics Control: COLOR, PLOT, POSN, LINE, DRAW, SCRN, GRAPHICS, TEXT, HIRES, ROT, SCALE, SHAPELOAD
- General Operations that Include and Extend Upon Dartmouth BASIC:
  - Program Manipulation: CLEAR, NEW LIST, RUN, CONT, LOAD, SAVE
  - Variable and Function Definition: DATA, DEF. FUNCT, DIM
  - Data Handling and Storage: READ, RESTORE, STORE, RECALL
  - Loops and Branching: FOR...NEXT, IF...GOTO, IF...THEN, ON...GOTO, ON...GOSUB, ONERRGOTO, RESUME, GOTO, GOSUB, RETURN
  - Input/Output and Format Control: INPUT, PRINT, IN#, PR#, VTAB, TAB, HOME, PADDLE
  - Machine Level Statements: PEEK, POKE, CALL, POP, LOMEM, HIMEM

Applesoft II is supplied as a cassette tape or a plug-in ROM card. The tape version runs in systems with 16K or more of RAM (24K or more for high-resolution graphics). The ROM version will run in 4K or more of RAM, but requires 16K RAM if high-resolution graphics are used. A comprehensive reference manual is included. (Order Numbers: A2B0009 — card, A2T0004 — tape.)

PROGRAMMER'S AID #1

Programmer's Aid #1 is a ROM-based library of routines to simplify and enhance your programs. It's capabilities include:

- High-Resolution Graphics Generation
- Program Renumbering and Linking
- Tape Verification
- Musical Tone Generation (12 timbres and 5 octaves)
- RAM Testing
- Machine Language Program Relocation

Programmer's Aid #1 is packaged as a single 2K-byte ROM to be inserted in socket D0 of the APPLE II. The routines upon which it is based are completely documented in the manual which accompanies the package. (Order No. A2M0019.)

APPLE SOFTWARE CATALOG

INFORMATION

The Apple Software Bank supplies software to adapt APPLE II to a wide range of applications. Currently available programs are listed below. Those marked with an asterisk (*) make up the Contributed Software section of the Bank.

EDUCATION

- Colormath—color/sound quiz in basic arithmetic.
- Hangman—color/sound guessing game that builds word skills.
- Mastermind—A popular strategy game that builds logic skills.
- The Infinite Number Of Monkeys/Integer Basic Subroutine Package—combining an enjoyable animated story with a serious exploration of advanced programming techniques in Integer BASIC.
- Engine—HI-RES animation of an automobile-type gasoline engine, including a manual step-through mode.
- The Great American Probability Machine—intuitive exploration of the laws of probability through LO-RES animation.
- California Driving Test—a practice test for California drivers and a fine example of educational programming for all.
- Hammurabi—a fascinating economic simulation of a small agrarian country. The lives and prosperity of its inhabitants depend upon the player's decisions.
- Morse Code—APPLE II now has a perfect fist over a wide range of speeds, for those who want to build their skill at Morse Code.

FINANCIAL CALCULATION & DATA HANDLING

- Finance I—financial analysis package that computes APR, present and future values of money, appreciation, interest, and payment rates for loans, leases, and savings accounts.
- Dow Jones Stock Quote Reporter—APPLE will hold a list of stocks and continually update bid or opening price, asked or closing price, high and low for the day, and the current volume of the stock. Stock portfolios are easily changed to suit the individual. All information is available (delayed 15 minutes) through a local phone call to the Dow Jones Service over most of the U.S.
- Dow Jones Portfolio Evaluator—using the Dow Jones service, APPLE can help manage your stock portfolio by displaying its contents, the value of each stock, total value, and long or short term gains and losses.
- Database Management—general data base for storing, searching, and sorting lists of all types of data.
- Checkbook With Financial Data Base Management—maintains a data base of transactions: the date, amount, recipient, and classification code for each item. It allows check records to be saved, sorted, searched, and displayed. Trial balances can be run, and the account can be reconciled against a bank statement. The program eliminates most of the drudgery associated with checking account management.

SCIENTIFIC CALCULATION

- Bone Tumor Differential Diagnosis—to assist qualified medical practitioners in the diagnosis of bone pathologies.
- Airfoil—HI-RES graphics program that will plot the shape of an aircraft wing given the parameters.

LANGUAGES

- LISP—a string-oriented language particularly useful in artificial-intelligence applications.
- Applesoft II—an advanced, floating-point BASIC interpreter that provides the computational power a user needs to program his own solutions to business, mathematical, and engineering problems. Built in transcendental and string functions, multi-dimensional array handling, and 9-digit arithmetic precision simplify the handling of a wide range of calculations.

APPLE SOFTWARE CATALOG

INFORMATION (CONT'D)

ENTERTAINMENT

- Startrek—a strategic exercise that pits your resources against hostile Klingons in an effort to save the Federation.
- Starwars—inspired by the popular movie, the game tests your reflexes as you attempt to shoot down attacking Imperial fighters.
- Breakout—A ball-and-paddle game with obstacles.
- Blackjack—the fun of Las Vegas without the risk.
- Chaser—exciting LO-RES graphics game; well-written and extremely challenging.
- Kaleidoscope—HI-RES ever-changing color pattern (requires PROGRAMMER'S AID #1).
- Mission: U-Boat—LO-RES deep-Atlantic action game: your ship against the submarines.
- Apple Organ—music and instructions for building a simple device to turn your APPLE into an organ.
- Add-Libs I—a fun party game for all ages.
- Shootout—a fine LO-RES game written by two 11-year-olds.
- Hustle—brilliant LO-RES arcade game with colors and bells and whistles galore.
- Apple-Vision—the classic APPLE HI-RES animation.
- Slot Machine—simulation of the one-armed bandit, with lots of color and action.
- Biorhythm—chart your physical, mental, emotional ups and downs over any 30-day period.
- Othello—a strategic board game that pits your skills against the computer in an attempt to dominate the board.
- Chess—the game of kings. A great way to build planning and logic skills.
- Pinball—bumpers, flashy colors, noise—everything is there but the slot for the quarters.
- Sink The Ship—as your aircraft wings across the sea, a ship plows through the waves. Press the bomb release and test your bombardier skills.
- Catch—a two-player game that combines the features of ping-pong and lacrosse.
- Curves—an abstract art program that generates ever-changing HI-RES patterns.
- Seven—this European version of Crazy Eights can simulate one to seven opponents for the player.
- Towers Of Hanoi—an ancient strategy game of cosmic significance.
- Nightmare #6—the object of this game is to figure out the object of this game.
- 23 Bricks—wherein the object is to force your opponent (the computer) to take the last of a collection of 23 bricks.
- Yahtzee—a classic game for 1–5 players and 5 (computer simulated) dice.
- Magic Lantern—a large collection of HI-RES images that show off the graphics capability of the APPLE.

UTILITY PROGRAMS

- HI-RES Graphics—a package of graphics routines to assist the user in plotting on the HI-RES screen.
- RAM Test—a test program that provides peace of mind during RAM expansion by testing the installed RAM.
- Datamover—a program used to move data and programs from one APPLE computer to another over the phone lines.
- HI-RES Character Set—a program to put characters on the HI-RES screen.

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